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REMOTE STORAGE

ILLINOIS FARMERS' INSTITUTE CIRCULAR  
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Lectures on Poultry  
Husbandry

AT THE

15th ANNUAL MEETING

HELD IN

Edwardsville, Illinois, February 22, 23 and 24, 1910.

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"THE STATE AND THE POULTRY MEN."

(Prof. James E. Rice, Professor of Poultry Husbandry, Cornell University,  
Ithaca, New York.)

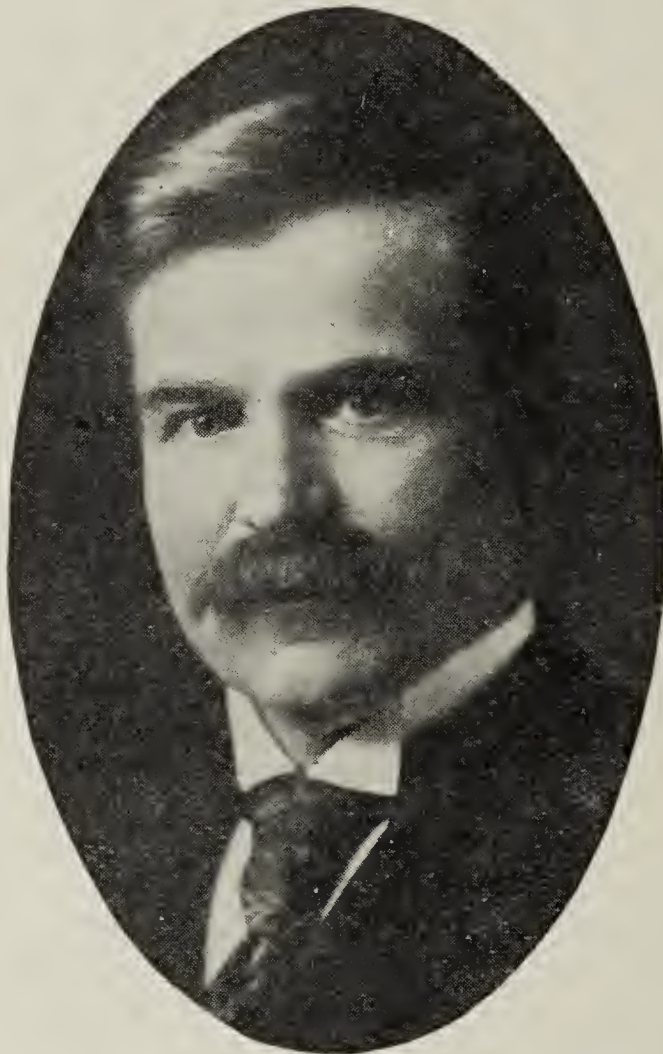
MR. PRESIDENT AND FARMERS OF ILLINOIS: I am free to say that Illinois is the biggest corn field I was ever in. I have just come from one end of the State to the other, and apparently I have not been out of a corn field a minute of the time. It would seem to me as though all the barns and the houses, and the manufacturing establishments, and the villages and cities were located in corn fields. I never knew before that I was born in a corn field, but I have the honor of having been born in Illinois. Consequently, I know now, although I was a little too young to appreciate it then, that I was born in a cornfield, and I am glad to get back to this, my native State.

It has been rather a surprise to me that the richest poultry state in the

Union should be one of the last to take up systematically the teaching and investigating in poultry husbandry. Illinois stands as the first state among all the richest states, agriculturally, and also as regards the value of the poultry and poultry products, according to the census of 1900, as you will see a little later in the lantern slides.

I have been asked to present, in the little time that we have available here, some of the chief reasons why poultry husbandry should be taught and investigated in the agricultural college and experimental station, and why poultry associations and every other educational organization in the State, the institutes, the fairs, and all the rest should be given State aid, as a good business investment. Money invested in any educational enterprise, provided it is properly and wisely expended, is perhaps the best paying investment that a state can possibly make.

Fundamentally, the chief reason why the State is justified in helping agriculture as a whole is that it is a basic industry, upon which all other occupations and professions primarily depend for their prosperity. Anything



PROF. JAMES E. RICE.

that will make a farmer prosperous will help to make all other people prosperous. This is particularly true of poultry, because poultry is an animal industry, and on this account is a long step in advance of grain farming, which means the sale of raw materials from the State, instead of increasing the animals within the State. This means a great deal when we come to look upon it broadly, in its ultimate influence upon the productivity of the land the prosperity of the farmer. Take for instance the poultry alone. You probably have in this State in the neighborhood of thirty million of hens; we have over twenty million in New York State.

Assuming that one-fifth, or thereabouts, of the actual money value of the feed of the hens will be left upon the farms, in the form of fertility, after the hens have taken their toll for their growth and their production, it would mean a saving in the State of Illinois alone of over six millions of dollars



annually, just in the keeping of the fertility here, as compared to sending the grain that you would have fed those hens, in other states, for somebody's use in manufacturing that raw material into the finished poultry products.

We need consider but a moment what better methods, by education and experimentation would mean to the prosperity of the farmers of the State. It will help us to know how, more economically and successfully, to build poultry houses, to feed poultry, to raise chickens, and to breed fowls. If by any or all of these means combined, we increase the production of the hens in the State one egg per hen, think what it would mean with thirty million of hens. Selling that egg at the average price of two cents will amount to over six hundred thousand dollars a year in the State of Illinois.

Increasing the value of a pound of the poultry meat one quarter of a cent and decreasing the cost of production of a pound of meat one quarter of a cent per pound, would mean two cents per fowl, and would have another six hundred thousand dollars added to the actual income of the poultrymen and farmers of the State of Illinois.

Now, are these things worth while? They are not beyond the range of possibility, in view of the actual results that have accrued upon hundreds and hundreds of farms in this State and in every other State, due to improved methods of feeding and handling of poultry.

Money spent in education in poultry husbandry is a good business investment. More than that, it is a State duty. A State that does not do these things for its poultrymen, is simply not living up to its obligation to the people, and the people can not keep up in the race of competition with the world when sister states are up to date and educating their poultrymen.

It makes all the difference in the world to you and to me and to the State whether we are putting a dollar into our pocket for something that we raised and sold, or whether we are pulling the dollars out of our pocket to send to a man in another state for something that he has raised and sold.

So long as a State does everything within its power to help its citizens, by better knowledge and better methods, to produce more economically and better quality, the standard of quality of live stock is raised and with it the standard of prosperity, until the people in other States are glad to send their money into this State to get the benefits of our improved breeding. Otherwise the breeders of this State would be sending their money into other states, paying it to the other fellow. We must face this situation. We must do in each state whatever may be necessary to develop the poultry interests along educational lines exactly the same as the others are doing. It is only fair and just to the poultrymen that this is done.

Poultry husbandry has an additional appeal to make. It is based on the fact that up to within a few years, only about five or six people were giving serious attention, serious thought, to the subject of teaching and investigating in poultry husbandry. For all these years since the Hatch Act, professors and scientific investigators have been helping to solve the problem of the dairyman, and of the fruit grower, and of the man engaged in every walk of agriculture except poultry.

Poultry has been left until the very last, and I presume naturally so. It is because the great mass of poultry is kept upon the farm as a mere incident, something that is merely a side issue. Although in the aggregate, poultry will closely approximate the value of the horticulture or the dairy interests in many of the States, and in some even surpassing them, yet taking it individually, poultry usually has amounted to only a little on any one particular farm. That is one of the reasons why it has not been given full consideration. Moreover, when you come to realize also that the poultry products of this country are worth five hundred million dollars, and when you consider that more people are directly interested in handling poultry than are interested in any other one agricultural industry, you will appreciate how it touches people from the human side.



Director Bailey of the New York State College of Agriculture, who was one of the very first to take serious recognition of Poultry Husbandry, says that with all due consideration for the commercial and financial advantages and other arguments, why poultry husbandry should be taught and investigated at the colleges and experiment stations, the one that appeals to him most is the fundamental argument that it is one of the best ways of reaching men and women as he describes it "in terms of their daily lives."

When you consult the experience of the states, few though they may be, where the colleges have been given an opportunity to teach and investigate, to publish bulletins, and to answer correspondence, you will find, I think, that without exception, the most enthusiastic have been surprised at the demand that has come from the people for poultry information. There is no kind of bulletin that is so quickly out of print at Cornell University or in Connecticut, or Rhode Island, or Maine, or any other state where the work has been given a fair opportunity to justify itself, than the poultry bulletin. They are out of print quicker than any other class. This shows the demand, as does also the correspondence, and how it is increasing.

Shall we, therefore, give the poultrymen the same opportunity as is given to other animal raisers, or shall we let them fight out for themselves their own salvation?

We are all one great nation wide family. Whatever is of benefit to one really in the end is a benefit to all. It is infinitely cheaper for a state to hire a few men who will devote their lives to the teaching and to the investigating of facts relating to poultry than it is for thousands upon thousands of poultrymen and farmers all over the State and the nation to go through the expensive, bitter experience of learning these things for themselves?

How much cheaper it is to have an experiment station, to hire a bacteriologist, a chemist, and a good poultryman, to work together in solving the cause and cure, of say, white diarrhea, than it is to let its devastations proceed in costly wastefulness.

Six states today have trained investigators working on that problem; they have found at least five or six different reasonable causes for the mortality in chickens.

Is it not cheaper for one state, like Maine, to spend a few thousand dollars, with trained people, to solve a law of production, through expensive trap nest experiments, and carefull bred pedigreed stock, than it is for hundreds of thousands of people all over the United States to try to find out that law for themselves, or go blindly facing the inevitable, year after year?

A state cannot make a better investment than to develop its poultry interests, and especially is this true of the State of Illinois, with its splendid crop producing power and extensive animal industries. Give the same proportionate attention to the poultry as she is now giving to other branches of agriculture, and the State of Illinois, when she finally wakes up to what she has been missing, and what she has failed to do in the past, is going to show the states that are already doing something for poultry, how it can be done in one of the richest and one of the best states in the Union.

I am very glad to be able to say that I know, from personal knowledge, that your splendid director and Dean, Dr. Davenport, is heartily in favor of this movement, and I am glad to chronicle that your poultry association—because I have had a good deal of correspondence with the officers—are thoroughly backing this movement.

When a movement to secure a Poultry Department for the Illinois State University is once started, probably nothing can stop it, and the Legislature will be as willing to promote the work as they have been in the State of New York. This last year, within the last four weeks, the Board of Trustees have recommended to the State Legislature, and the bill has been drawn and introduced, both in the Senate and Assembly, calling for ninety thousand dollars, to be put into a building for the department of poultry husbandry alone, and this to be followed later with twenty thousand dollars, at least, for additional buildings and equipment.



Now, friends, what I am saying about the demands of the people for a strong poultry department is not snap judgment. It is based purely upon seven years' experience. When the New York State Branch of American Poultry Association met last year, at Cornell, and investigated for themselves our needs, they recommended that fifty thousand dollars be asked of the legislature. When the Board of Trustees considered the question of an appropriation to poultry husbandry, they raised it to sixty thousand. Now that the bill has been introduced, it has been raised to ninety thousand. Just as sure as the sun shines, within three years—one year after that building is completed—every available spot in it will be in active use.

Six years ago we had twenty-seven students taking poultry. Registration has gone up, year after year, until last year we had 167 students taking poultry courses, notwithstanding the fact that all the courses in poultry husbandry are purely elective. This year we have been obliged to turn them away. For at least two years we have had people from the State of Illinois, and we have had them from nearly all the states of the union. I say these things not because it applies particularly to New York. The same statement can be made with regard to Rhode Island, Connecticut, Maine, and nearly every other state where they have given poultry husbandry a fair opportunity to justify itself.

The rest of the address will be given over to a rapid review of lantern slides with the particular object of showing you, first statistically and graphically, where poultry husbandry stands in relation to two great agricultural industries, dairying and horticulture, and secondly, to show you some of the poultry departments in the other states of the Union.

There are over thirty states now giving instruction, and carrying on investigation in poultry husbandry. This last year Illinois has fallen into line through the work of Professor Barto in teaching teachers poultry husbandry.

Now, if the lights will be turned off, the slides will run rapidly.

This table of figures shows you where Illinois stands:

Value of eggs produced in 1899:

|                   |              |               |              |
|-------------------|--------------|---------------|--------------|
| Ohio .....        | \$10,280,769 | Iowa .....    | \$10,016,707 |
| Pennsylvania..... | 9,080,725    | Illinois..... | 8,942,401    |
| New York .....    | 8,630,062    | Missouri..... | 8,315,371    |
| Indiana.....      | 7,441,944    | Kansas.....   | 7,237,111    |

Comparison of eight best poultry states (value over three months old in 1900):

|                   |             |               |             |
|-------------------|-------------|---------------|-------------|
| Iowa .....        | \$6,535,464 | Illinois..... | \$6,415,033 |
| Missouri .....    | 5,720,359   | Ohio .....    | 5,085,921   |
| Pennsylvania..... | 4,483,486   | Kansas.....   | 4,356,597   |
| New York .....    | 4,310,755   | Indiana.....  | 4,222,409   |

Value of poultry and eggs produced in 1899:

|                   |              |                |              |
|-------------------|--------------|----------------|--------------|
| Illinois.....     | \$20,250,000 | Iowa .....     | \$19,508,526 |
| Ohio .....        | 19,127,778   | Missouri ..... | 17,840,623   |
| Pennsylvania..... | 16,231,968   | Indiana .....  | 15,614,937   |
| New York .....    | 14,791,491   | Kansas.....    | 13,728,294   |

Value of poultry raised in 1899:

|                |              |                   |             |
|----------------|--------------|-------------------|-------------|
| Illinois.....  | \$11,307,599 | Missouri .....    | \$9,525,252 |
| Iowa .....     | 9,491,819    | Ohio .....        | 8,847,009   |
| Indiana .....  | 8,172,993    | Kansas.....       | 6,491,183   |
| New York ..... | 6,161,429    | Pennsylvania..... | 7,151,243   |

You will see that the rating depends upon what value you place upon the poultry products and how you estimate them.

When you take the value of eggs produced in 1899, the order of the states is: Ohio, Iowa, Pennsylvania, Illinois, New York, Missouri, Indiana, Kansas. Value of eggs and poultry in 1899, it stands: Illinois, Iowa, Ohio, Missouri, Pennsylvania, Indiana, New York and Kansas. When you take the value of the poultry, including those over three months: Iowa, Illinois, Missouri, Ohio, Pennsylvania, Kansas, New York, Indiana. In just the value of the poultry raised in one year, 1899 it stands: Illinois, Missouri, Iowa, Ohio, Indiana, Kansas, New York, Pennsylvania.

Of these eight greatest poultry producing states, let us see what they are doing for poultry husbandry. The Ohio Experiment Station has just started, for the first time, a few coöperative experiments. The College at Columbus has started to give a short poultry course of a few weeks.

Iowa only three or four years ago established a poultry department with twenty acres of land and has a fair start in the matter of buildings, equipment, and a good man in charge.

Pennsylvania has started also and has been going for a few years, carrying on some experimental work and giving a short winter course, but it has not really gotten under way in a justifiable sense for so important a state.

Illinois has just started with Professor Barto in the teachers' work this last year.

New York, for about eighteen years, has been giving a few lectures at Cornell and carrying on some experimental work at Geneva and Ithaca, but only within recent years has the department been given an opportunity to justify itself.

Missouri has done nothing, so far as the college and experiment station is concerned, but has given an appropriation, which is a liberal one, to the State Poultry Board, for carrying on show work and the institute work, which is a very favorable indication.

Indiana this year, for the first time, has given ten thousand dollars, to be used at the rate of five thousand dollars each year. This is a mere pittance for so great a state, but they mean business.

Kansas has for a few years been working along this line, and now has a fairly good department under way, and are now producing good results.

What a showing is that, however, for eight great prosperous states?

Fig. 1 is a graphic representation of the amount of money that is given by each state to the agricultural college and experiment station, and the value of its poultry products as compared to each dollar invested in the college and experiment station for dairying, horticulture and poultry.

Proportionate value of dairy, horticultural and poultry products, compared to money expended by the seven largest poultry states, expressed in value of production to one dollar for instruction and investigation:

| States.           | Products.          | Amount.    |
|-------------------|--------------------|------------|
| Illinois.....     | Dairy.....         | \$ 456     |
|                   | Horticulture ..... | 435        |
|                   | Poultry .....      | 20,500,000 |
| Iowa .....        | Dairy.....         | 236        |
|                   | Horticulture ..... | 143        |
|                   | Poultry.....       | 1,466      |
| Kansas.....       | Dairy.....         | 327        |
|                   | Horticulture ..... | 45         |
|                   | Poultry.....       | 1,017      |
| Missouri.....     | Dairy.....         | 418        |
|                   | Horticulture ..... | 82         |
|                   | Poultry.....       | 17,840,000 |
| New York.....     | Dairy.....         | 493        |
|                   | Horticulture ..... | 1,354      |
|                   | Poultry.....       | 753        |
| Ohio .....        | Dairy.....         | 1,011      |
|                   | Horticulture ..... | 627        |
|                   | Poultry.....       | 19,127,000 |
| Pennsylvania..... | Dairy.....         | 335        |
|                   | Horticulture ..... | 957        |
|                   | Poultry.....       | 3,214      |



In other words, taking the State of Illinois, for instance, for every dollar expended in the college and experiment station for dairying, there are produced in the State \$450 worth of dairy products; for horticulture, \$435; but inasmuch as nothing was done for poultry, and the value of the poultry products was twenty million and over, therefore, poultry was contributing to the prosperity of the State and its actual production, twenty million dollars, and nothing being done to assist it.

In Iowa it was: For dairying, \$236, and horticulture, \$143. In poultry they were contributing at the ratio of \$1,466.

So you can follow down the line and you will see that in every one of these states poultry is actually giving, by way of production, to the prosperity of the State vastly more than is being given back, in the way of instruction and experimentation, so far as we may compare the other agricultural industries.

Fig. 2 shows the same thing, combined, from all of the states.

Proportional value of dairy, horticultural and poultry products compared to moneys expended by all the states reporting, expressed in value of production to one dollar expended for instruction and investigation:

|                    | Land, stock,<br>building and<br>equipment. | Salaries<br>and<br>maintenance. | Total<br>expenditure<br>including<br>permanent<br>investment. |
|--------------------|--------------------------------------------|---------------------------------|---------------------------------------------------------------|
| Dairy .....        | \$ 523 00                                  | \$1,771 00                      | \$ 404 00                                                     |
| Horticulture ..... | 402 00                                     | 1,151 00                        | 319 00                                                        |
| Poultry .....      | 2,108 00                                   | 4,614 00                        | 1,447 00                                                      |

For instance, taking all the states into consideration, for every dollar expended in the college and experiment stations for the teaching and investigation of dairy products, \$523 are produced in value in these states, and in horticulture \$402, whereas for poultry it is \$2,108. It is shown graphically.

Average amount invested in poultry investigation as based on the states reporting:

1907

|                        | No. stations<br>reporting. |              |
|------------------------|----------------------------|--------------|
| Land .....             | 15                         | 8.3 acres.   |
| Stock .....            | 20                         | \$ 894 00    |
| Buildings .....        | 22                         | 2,690 00     |
| Equipment .....        | 21                         | 759 00       |
| Total .....            | 26                         | 5,129 00     |
| Salary and maint. .... | 24                         | 2,538 00     |
| Total value .....      | 30                         | 6,476 00     |
| Products .....         | 53                         | 5,305,335 00 |

1908

|                        |    |              |
|------------------------|----|--------------|
| Land .....             | 22 | 9.5 acres.   |
| Stock .....            | 27 | \$ 894 00    |
| Buildings .....        | 30 | 2,386 00     |
| Equipment .....        | 26 | 586 00       |
| Total .....            | 32 | 5,059 00     |
| Salary and maint. .... | 27 | 2,785 00     |
| Total value .....      | 32 | 6,231 00     |
| Products .....         | 52 | 5,305,335 00 |

1909

|                       | No. stations reporting. |                             |
|-----------------------|-------------------------|-----------------------------|
| Land.....             | 28                      | 8.4 acres, val. \$ 1,378 00 |
| Stock.....            | 30                      | 1,312 00                    |
| Buildings.....        | 29                      | 4,354 00                    |
| Equipment.....        | 28                      | 787 00                      |
| Total.....            | 30                      | 7,543 00                    |
| Salary and maint..... | 29                      | 3,727 00                    |
| Total value.....      | 30                      | 11,145 00                   |
| Products.....         |                         |                             |

When you take the actual value of all combined, in salaries and maintenance, equipment, permanent investment and all, dairying is producing \$404, horticulture \$319, while poultry is producing \$1,477 for each dollar expended in the experiment stations and colleges.

Fig. 3 is another way of showing the same general statement, by statistics.

Summary of money invested in United States for instruction and investigation:

|                   |        |
|-------------------|--------|
| Dairy.....        | \$6 00 |
| Horticulture..... | 7 00   |
| Poultry.....      | 1 00   |

Summary of money expended annually in United States for instruction and investigation:

|                   |        |
|-------------------|--------|
| Dairy.....        | \$4 00 |
| Horticulture..... | 4 00   |
| Poultry.....      | 1 00   |

Proportionate value of products in United States:

|                   |     |
|-------------------|-----|
| Dairy.....        | 1.7 |
| Horticulture..... | 1.3 |
| Poultry.....      | 1.0 |

We have, for every one dollar expended in the colleges and experiment stations for poultry, seven dollars expended for horticulture, and six dollars for the dairy, in permanent investments.

For salaries and maintenance, we have throughout the United States, for every dollar given in the experiment stations and colleges for poultry, four dollars for dairy, and four dollars for horticulture.

Now, taking the census of 1899, to find out the way in which these three great agricultural industries contribute to the wealth of the nation, we find that for every dollar that poultry contributes, horticulture contributes 1 3/10, while dairying contributes 1 7/10. Comparing poultry keeping with dairying and horticulture, in the proportion of what is produced, it is obvious that poultry is not given a fair recognition as compared with the other agricultural industries.

A few years ago the American Poultry Association appointed a committee to assemble these statistics from all over the United States and Canada. The following table shows the summaries of what they found up to the present time. The columns shown are the value of the land, stock, buildings, equipment, and the totals, then the salaries and maintenance, and the total of all, computed from the different states reporting.

Total agricultural college and experiment station poultry investments:

1907

|                       | Number stations reporting. | Poultry Total. |
|-----------------------|----------------------------|----------------|
| Land.....             | 15                         | 125 acres      |
| Stock.....            | 20                         | \$ 17,895      |
| Buildings.....        | 22                         | 59,700         |
| Equipment.....        | 21                         | 15,937         |
| Total.....            | 26                         | 126,263        |
| Salary and maint..... | 24                         | 60,928         |
| Total.....            | 30                         | 194,281        |



1908

|                              | Number<br>stations<br>reporting. | Poultry total. | Per cent<br>increase. |
|------------------------------|----------------------------------|----------------|-----------------------|
| Land.....                    | 22                               | 178¼ acres     | 43.00                 |
| Stock.....                   | 27                               | \$ 21,879      | 22 33                 |
| Buildings.....               | 30                               | 71,602         | 20.90                 |
| Equipment.....               | 26                               | 15,261         | (4.00 decrease)       |
| Total.....                   | 32                               | 140,199        | 11.40                 |
| Salary and maintenance ..... | 27                               | 75,117         | 23.20                 |
| Total.....                   | 42                               | 198,027        | 1.90                  |

1909

|                              |    |                            |    |
|------------------------------|----|----------------------------|----|
| Land.....                    | 28 | 277 acres (value \$38,585) | 55 |
| Stock.....                   | 30 | \$ 39,368                  | 79 |
| Buildings.....               | 29 | 126,283                    | 76 |
| Equipment.....               | 28 | 22,053                     | 44 |
| Total.....                   | 30 | 226,289                    | 60 |
| Salary and maintenance ..... | 29 | 108,080                    | 43 |
| Total.....                   | 30 | 334,369                    | 68 |

The sets of columns show a comparison of the figures for 1907, 1908 and 1909. Large increases are shown in land, stock, buildings, equipment, persons employed, and in every other respect.

The value of stock in all the states of the Union, for poultry at the colleges and experiment stations for 1907 was \$17,000, and the next year \$21,000, this last year, 1909, \$39,000.

For buildings it was \$59,000, \$71,000, and now it is \$126,000.

For equipment it was \$15,000, about the same the second year and this year \$22,000.

For salaries and maintenance it was, in 1907, \$60,000, 1908, it was \$75,000 and now \$108,000.

Taking the totals three years it was \$194,000, then \$198,000, and now \$334,000, showing how the jump has been made in the last few years.

Again, we show the averages. I will not take the time to dwell on this in detail, but simply call your attention to the fact that when you come to average up what is being done by each of the states that are carrying on work, you will find that so far as the land is concerned, 28 states reported an average of 8.4 acres given over to poultry. So far as stock is concerned, the average value was \$1,300. For buildings, the average was \$4,300; for equipment \$787, and so on down, to the total value of the poultry department as a whole, which averages, in all the states that have departments, 30 in number, \$11,000.

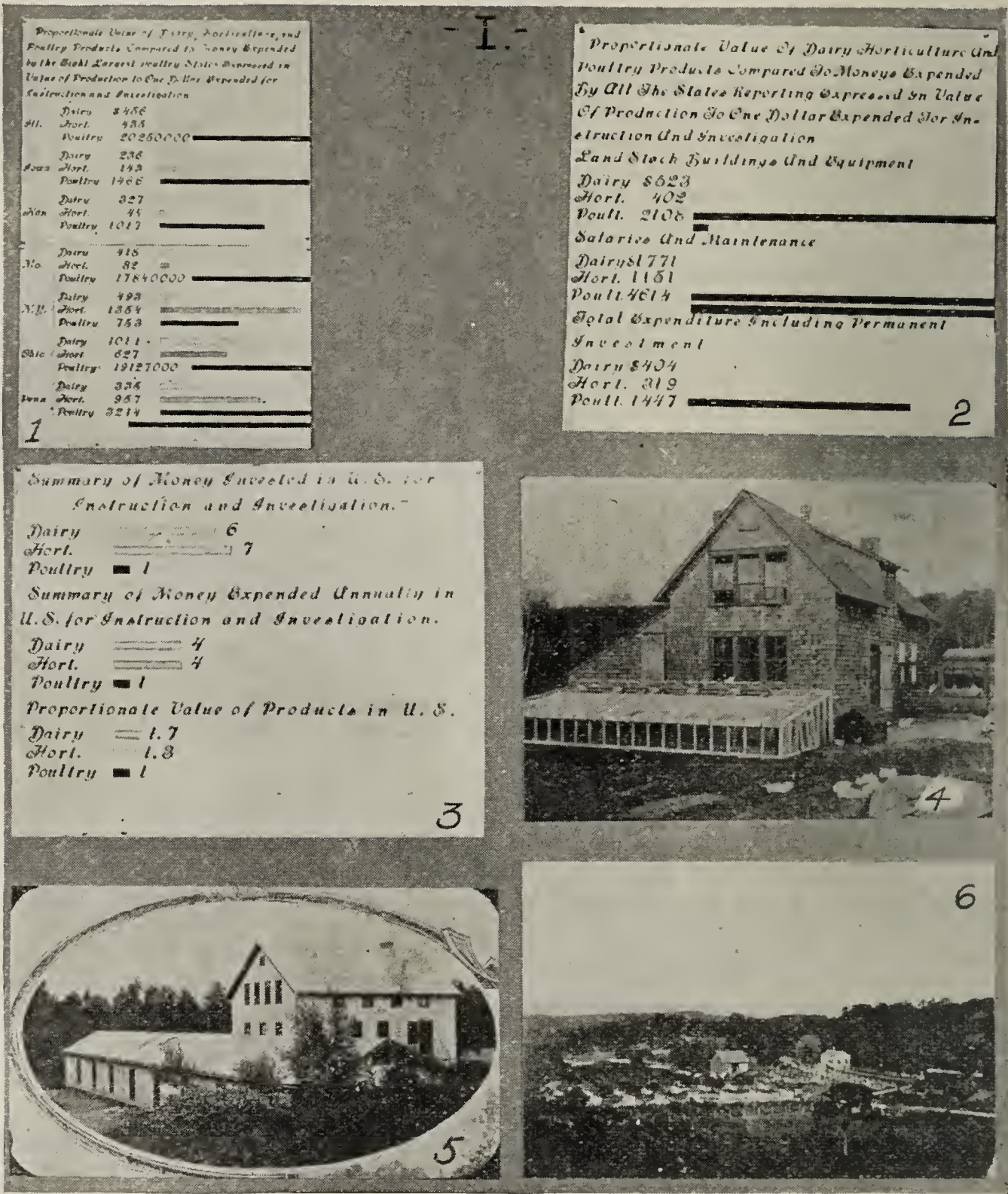
(Average table, 1909, displayed as follows: by way of recapitulation):

|                              | Number<br>stations<br>reporting. |                           |
|------------------------------|----------------------------------|---------------------------|
| Land .....                   | 28                               | 8.4 acres, value \$ 1,378 |
| Stock .....                  | 30                               | 1,312                     |
| Buildings .....              | 29                               | 4,354                     |
| Equipment.....               | 28                               | 787                       |
| Total .....                  | 30                               | 7,543                     |
| Salary and maintenance ..... | 29                               | 3,727                     |
| Total value.....             | 30                               | 11,145                    |

We will now take a rapid review of some of the poultry departments of different states, with slides showing the buildings. This first slide is one showing the equipment at Rhode Island, one of the first states to start the



work. They established a poultry department and had the first poultry school in the year 1898. Since that time they have been giving a six weeks, or longer, course.



The first systematic attempt to teach poultry husbandry, however, was in New York at Cornell University, where in 1892, a course of ten poultry lectures was given to fifty students, and this was continued each year until the subject was recognized as a sub-department of animal husbandry in 1903.

Following directly after Rhode Island, Connecticut established a poultry school, and then a little later Maine, and then Utah and Kansas, and later Iowa and Michigan, and Maryland and so on, until at the present time we have thirty different states where the agricultural college or experiment station are doing something with poultry.

Fig. 4 shows the first building erected at the Rhode Island Experiment Station, where they devote all the space to the investigational work.



Rhode Island has carried on experiments in black head in turkeys for nine years, and think they have ascertained the cause. They find it is due to a bacteria or fungus that works on the liver, and is transmissible from one turkey to another. It apparently cannot be cured, but can be prevented by immunity of the stock in breeding, and by getting rid of the domestic fowl, not letting the hens and turkeys run together. The fowl apparently develops this disease in a weak form and it is not fatal, as a rule, while the turkey gets it from the hens and very quickly succumbs.

Fig. 5 shows the instructional building in Rhode Island, built with five thousand dollars appropriated especially for teaching work.

Fig. 6 shows part of the poultry plant of little Connecticut. They have been giving us a good example of what a little state can do in developing its poultry interests. This shows the main building, the barn, the main poultry house, and where they raise the chicks.



One of the valuable features in Connecticut is the summer work, in which they hold summer meetings of the poultry association which has representatives in every county in the State. They meet at different farms and have lectures and demonstrations. Four hundred or five hundred people sometimes assemble. One of their meetings is shown in Fig. 7.



Fig. 8 is the poultry plant at Guelph, Ontario. They have been giving us some of our very best results both in teaching and investigating for fifteen years or more. They probably have more money invested in several of their poultry departments in Canada than we have in the United States, so far as the principle stations are concerned. They have one at Quebec, and one at Guelph, and one at Ottawa. They have been doing some of the most practical work that has been done by any of the stations.

Fig. 9 shows one of the experiments at Guelph, Ontario. They have been working for ten or fifteen years, comparing poultry houses of different types. Their conclusion is that the cool house, the rather open fresh-air house, has given them, all things considered, their best results.

A good indication of what may be done in the experiment station, in the developing of good meat-type poultry is shown in Fig. 10. This is a picture I took at Guelph, of the best male and female. In eight years of systematic breeding for meat production, they have developed a strain of meat-type Barred Rocks. Any of you who are familiar with the meat type will see at once how it is modified to meet the conditions, in the broad breast with lots of meat on it, short joints and little waste parts, short thick neck and broad back. It is a superior meat type and has been a winner at many of the shows.

Question—How are those for layers?

Prof. Rice—Not as good as others. Whenever you increase to a high degree quick growth and the right type for meat, you have the general tendency that follows naturally, to decrease productivity; the same result that you would expect in the case of the beef cattle when compared to the dairy cow type as regards milk production.

Fig. 11 shows only one picture of the West Virginia experiment station, where they have published splendid results on the value of skim milk, comparative value of pure bred and mongrel stock, methods of running incubators, and feeding experiments of various kinds. They have given out several bulletins of great value.

I can only show one or two pictures of the West Virginia poultry department. This shows the range, where they rear the stock. They have also been giving us results on the comparative value of breeding from hens and pullets, in six different experiments, published a few months since.

Maine is more in the public eye, at present, probably than any other station and they have a right to be, because they have demonstrated the value of several exceedingly important methods in the modern handling of fowls. The curtain front house was proven feasible, after others, however, suggested it, and the hopper system of dry feeding was emphasized as was also the question of inheritance and the function of egg production.

The late Prof. Gowell was one of the first to bring out several progressive and valuable ideas. These have had great influence on our modern methods of building houses, breeding, feeding, etc. The poultry work in Maine illustrates the influence of the good work of one state upon all.

Fig. 12 is one of the large houses in which they keep their stock at the Maine experiment station.

Fig. 13 shows the Pennsylvania poultry buildings. They have one man and an assistant giving all their time to the poultry. Prof. Hunt pointed to twenty acres of beautiful land when I was there last and said, "Just as soon as we can get the right man educated to take care of this poultry department, he can have twenty acres of our best land on which to carry on the poultry work."

Fig. 14 shows one of the houses at the Kansas experiment station, where they have a college graduate in charge of their department who is doing a good work. He is making a special study of the market conditions of eggs and has recently written a valuable bulletin on the subject.

Fig. 15 is another poultry house at the Kansas experiment station. When these large, rich, middle west states once get under motion, we expect they will show us in the east how to do things.



Fig. 16 is the poultry plant at the Maryland State Experiment Station. A few years ago I had a letter from Prof. Patterson, who said he would be glad to start a poultry department, if he thought there was anything to investigate. He said his people felt there "wasn't anything they wanted to know." I pitied them to the bottom of my heart, and wrote several pages of experiments that ought to be investigated. He started his poultry department. It is now one of the most popular departments at the station and they are all very much pleased. They have a trained bacteriologist working on poultry diseases, and a practical poultry man looking after the plant.

Fig. 17 shows the Michigan poultry department, where they have a thoroughly trained man, devoting all his time with one or two assistants, carrying on the poultry work.



Prof. Dryden left Utah a few years ago where he had been doing excellent work, and went to Corvallis, Oregon. They have given him a splendid opportunity to show what can be done scientifically in helping poultrymen to solve problems in incubation. They gave him five thousand dollars for



buildings, equipment and apparatus, to investigate incubator problems. He has already given us some very valuable information and there is much more to follow.

Fig. 18 shows the interior and exterior of their incubator building.



Fig. 19 shows a picture of the winter poultry course at the Ohio State University, when they first tried it two years ago. They are going to the Legislature this year for ten or fifteen thousand dollars for the poultry work and expect to get it. Please note that as a rule the poultry department is the last one to be established in a college. Consequently it is the one given least consideration until it makes good.

Fig. 20 shows what a director of one of our neighboring states did to help the poultrymen of his state, and he is one of our best directors. He apparently did not have the money; possibly he did not have the inclination to start poultry experiments. He certainly did not feel justified in establishing a poultry department, but he did do this much; he told his people where they could get the information. Inquiries evidently came in so rapidly to his station, asking where people could get poultry information, that instead of doing the work and finding out himself, he printed a postal card,



giving the names of all the states where people could write and get the information if they wanted it. (Laughter.) We are all glad to know that this director is now looking for a man to start the poultry work.

Down in Tennessee they did not want to take land that they could use for their cows or for any other purpose, so they took a side hill, too steep for cattle and gave it to the poultry department. It may be needless to say that this poultry venture did not succeed, not wholly due to the land however.

(Fig. 21.) The poultry department put in five or six terraces on the steep side-hill and put chicken houses on each terrace, and put a stairway leading up to the top floor. The chickens could run on that land and pasture on it, by using their wings if necessary. They did not dare to put the cows there, for fear they would get lopsided.

Three or four pictures follow of the Cornell poultry plant, which is very small. We only have four or five acres we can call our own. We are working on a very much congested and wholly improper plan. We are hoping for forty or fifty acres of land for a poultry farm. The director of the college and the president of the university have promised us a farm in the very near future.\*

Fig. 22 shows the main building, and the long poultry house which the State gave us for teaching the students. The latter cost two thousand dollars and contains twenty-three pens.

Fig. 23 is a colony house, where the chickens are reared in flocks of 200 to 250.

Fig. 24 shows a closer view of where the chickens are raised. We call on the women to do the feeding of the young chickens.

Fig. 25 is another view of the Cornell plant, showing how it is congested, with little bare yards along the entire rear of the long poultry house.

Fig. 26 shows the house with cloth curtains in winter.

Question—Do these houses face the south so the sun will shine in?

Prof. Rice—Yes, all face the south.

One of the ways in which we try to reach the people of the State, is to have a card of which this is a front side (Fig. 27.). The children and others will get it and keep it because it contains a picture of chickens. It gives the address, so they will not forget where to write. On the other side is shown the ten ways in which we are trying to help the poultrymen. (Fig. 28.)

We will now have a brief review of the ways in which a poultry department can be of benefit to the people of the State.

*First*—By conducting experiments with poultry such as feeding, breeding, housing experiments, and the publishing of the bulletins. We expect, this year, to publish six bulletins relating to poultry.

A few years ago we were getting only three or four bulletins a year from different stations. This year we will probably have more than forty poultry bulletins published in the United States.

*Second*—By correspondence. The first year at Cornell we were getting in the neighborhood of 1,500 to 2,000 letters a year. Each year the number has increased until last year we had about eight thousand letters, and this year we will probably send out about ten thousand letters—entirely poultry correspondence.

*Third*—By special instruction in regular winter courses. We have, this year, about 154 students, taking some kind of poultry work. Fifty-five of these spent twelve weeks time with us and did nothing except to study poultry. We will see some of those study exercises a little later.

*Fourth*—By showing visitors the poultry department. You would be astonished to know how many people are interested in chickens, and who will come a long way to look at the experimental work, study the varieties and ask questions.

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\*NOTE—A fifty acre farm has been turned over to the poultry department since this lecture was delivered.



*Fifth*—By personal assistance in selecting breeding pens. We have several persons connected with our staff who, upon call, and dividing the expense with the breeder, will go out and select and mate up the pens in the spring of the year.

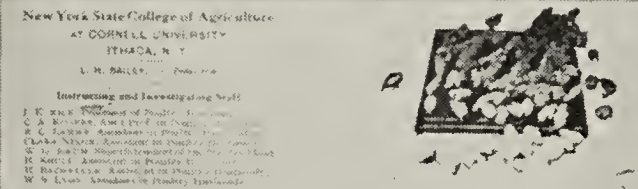
*Sixth*—By poultry reading course lessons. We have published eight of these on breeding, housing, raising chickens for market, and so forth, which the people of the State read, answer the questions and return with the correspondence.

The number of people who have taken these lessons will be indicated by the fact that large editions of 20,000 to 30,000 copies of each of the eight lessons have been practically exhausted.

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26




27



**New York State College of Agriculture**  
**AT CORNELL UNIVERSITY**  
**ITHACA, N. Y.**  
*L. H. BAILEY, Director*  
*Instructing and Investigating Staff:*  
*J. E. RINE, Professor of Poultry Husbandry*  
*C. A. BROWN, Assistant Professor of Poultry Husbandry*  
*W. C. LUTHER, Assistant Professor of Poultry Husbandry*  
*CLARA NIXON, Assistant Professor of Poultry Husbandry*  
*W. D. BROWN, Assistant Professor of Poultry Husbandry*  
*H. KATZ, Assistant Professor of Poultry Husbandry*  
*W. B. BROWN, Assistant Professor of Poultry Husbandry*  
*W. D. LUTHER, Assistant Professor of Poultry Husbandry*

**Department of Poultry Husbandry,**  
**ITHACA, N. Y.**

Keep this card.      Read the other side.      Ask for what you want

28

Ways in which the Department of Poultry Husbandry is endeavoring to assist the Poultrymen of the State.

1. By conducting experiments with Poultry, and for the benefit of Poultrymen.
2. By correspondence.
3. By special instruction in regular and winter courses.
4. By showing exhibits the Poultry Department.
5. By personal assistance in selecting breeding pens.

The Department of Poultry Husbandry in Co-operation with the Extension Department.

6. By Poultry reading course lessons.
7. By educational exhibits at the Fairs and Poultry Shows.
8. By Lectures and Demonstrations at Poultry Associations and Poultry Shows.
9. By Lectures in Poultry Husbandry at Rural Schools.
10. By personal assistance with poultry business.

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*Seventh*—By educational exhibits at the fairs and poultry shows. Each year, for the last five or six years, we have had what we call educational exhibits, in connection with the poultry shows and fairs, in order that the people might see the results of the experiments in photographic form, or by charts and models and live chickens. We will see a little later one of those exhibits, and you can see for yourself what it means. Just to illustrate how effective this type of extension work is, in reaching the people, I will give you the facts. Take for instance, the Batavia County Fair. There we received the names and addresses of 770 people who wrote out an application for our poultry literature. At the State fair we received an even thousand names and addresses. At the Madison Square Garden poultry show, in the heart of New York City, where people had to pay fifty cents for admission, and therefor must be interested in poultry, they came to the exhibits and left their names to the extent of 1,463; and at the International Show at Buffalo, we capped the climax by having the names of 2,780 people most of whom apparently had never received poultry literature from the institution. We require them to make a written request, writing the name and address and leaving the card with us.

*Eighth*—We also aid the associations by giving lectures and demonstrations. A lecture or two is given each day, or during certain days to discuss methods of feeding, breeding, housing, etc. By this means a new clientage is brought to attend the show, and to get interested in pure bred poultry. Many of these people never would have attended a show, if it had not been for something on the program on the utility side. Once they are there, they learn to appreciate good poultry and become interested to the extent of purchasing it.

*Ninth*—By lessons in poultry husbandry in the rural schools. Our station is trying to get the boys and girls interested. We prepared a series of eight lessons. We are going to increase these until we have a full course, including a study of the eggs, feathers, combs, and breed types, etc., so that the boys and girls will by easy stages come to know good poultry when they see it, and how to take care of it.

*Tenth*—Coöperative experiments with poultry. The farmers keep the records of their fowls and give us the results.

Now for a very few slides, showing methods of teaching the subject of poultry husbandry. I can only show you comparatively few on account of lack of time.

Fig. 29 shows an incubator cellar. The students are doing the work of running the machines. We put through the incubator practice course this year something like ninety students who ran the machines and kept the records connected therewith.

Fig. 30 shows the "study of the egg" where the students will cut the eggs, which have been boiled, and name the parts and tell the function and use of each part, the shell, the membrane, etc. By this study they can understand what the hen is expected to do when she manufactures an egg.

Fig. 31 is a study of chick feeds. The student is expected to learn the composition and quality of about fifty feeds fed to poultry.

Here (Fig. 32) they are making egg crates for private family trade. We try to give the students as much experience as possible in working with their hands as well as their heads.

Here (Fig. 33) they are studying the anatomy of poultry, cutting up poultry to see what the digestive functions are, and naming the parts with a view to a better understanding of the feeding problem.

Every student has a pen with a flock of hens. He has to look after them for six weeks, keeping the records of the amount fed, the droppings, the time taken for doing the work, and the profit or loss.

Fig. 34 shows the students taking care of these fowls. Leghorns are generally regarded as being a little wild, but they can be tamed if handled properly. (Indicating).



In all our teaching, the principle is to try to have the student do the thing himself. No matter how much we may lecture, no matter how much we may teach from the books, the subject can never be rightly grasped until the student does the work. Otherwise we cannot expect good results.

(Fig. 35). Here they are making crates to ship the dressed poultry.

(Fig. 36.) Here they are washing hens for the poultry show. Every year, until this year, we have held a poultry show at Cornell. Now we have been obliged to give it up because we had no room in which to hold the show. If we get our new poultry building next year, we will resume that



very valuable feature of the work. The students are expected to select the fowl on their own judgment in the breeding pens, and to wash a fowl or more apiece.

Question—Do you use anything in this wash to prevent nits and lice?

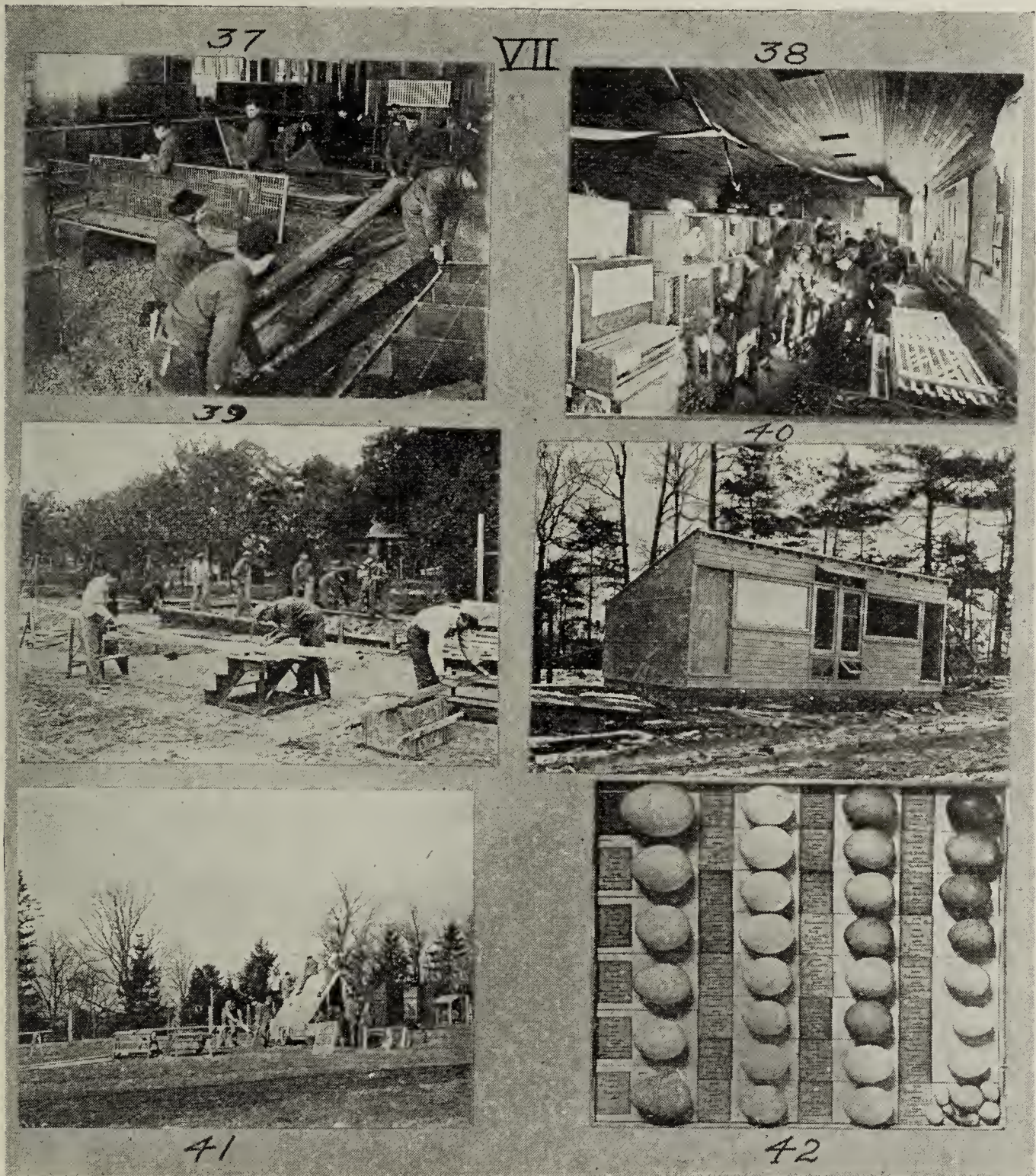
Prof. Rice—We make a louse powder at four cents a pound which serves the purpose of effectually killing the lice. It was invented by R. C. Lawry, an assistant in the poultry department at Cornell. The powder is made as follows: Mix one-fourth pint crude carbolic acid with three-fourths pint gasoline, stir this thoroughly into two and one-half pounds of plaster of paris, and sift through wire mosquito netting; then dry and dust through feathers.



(Fig. 37.) Here the boys are setting up the coops in the show. Each year they run the show themselves, do all the work, manage all the details, and exhibit the fowls. They then judge the fowls under competent instructors, so that when they get to their own homes they will understand how to organize a poultry show.

(Fig. 38.) Here they are judging the fowls for prizes which are offered for the student who makes the best records.

In Fig. 39 they are building a poultry house. Every year we try to build a new laying house, a colony house, or something of that kind, so the students can actually do the work, as well as observe how it is done from books and lectures.



(Fig. 40.) Here they built a house, painted it, put in the stone foundation, and did everything from start to finish.

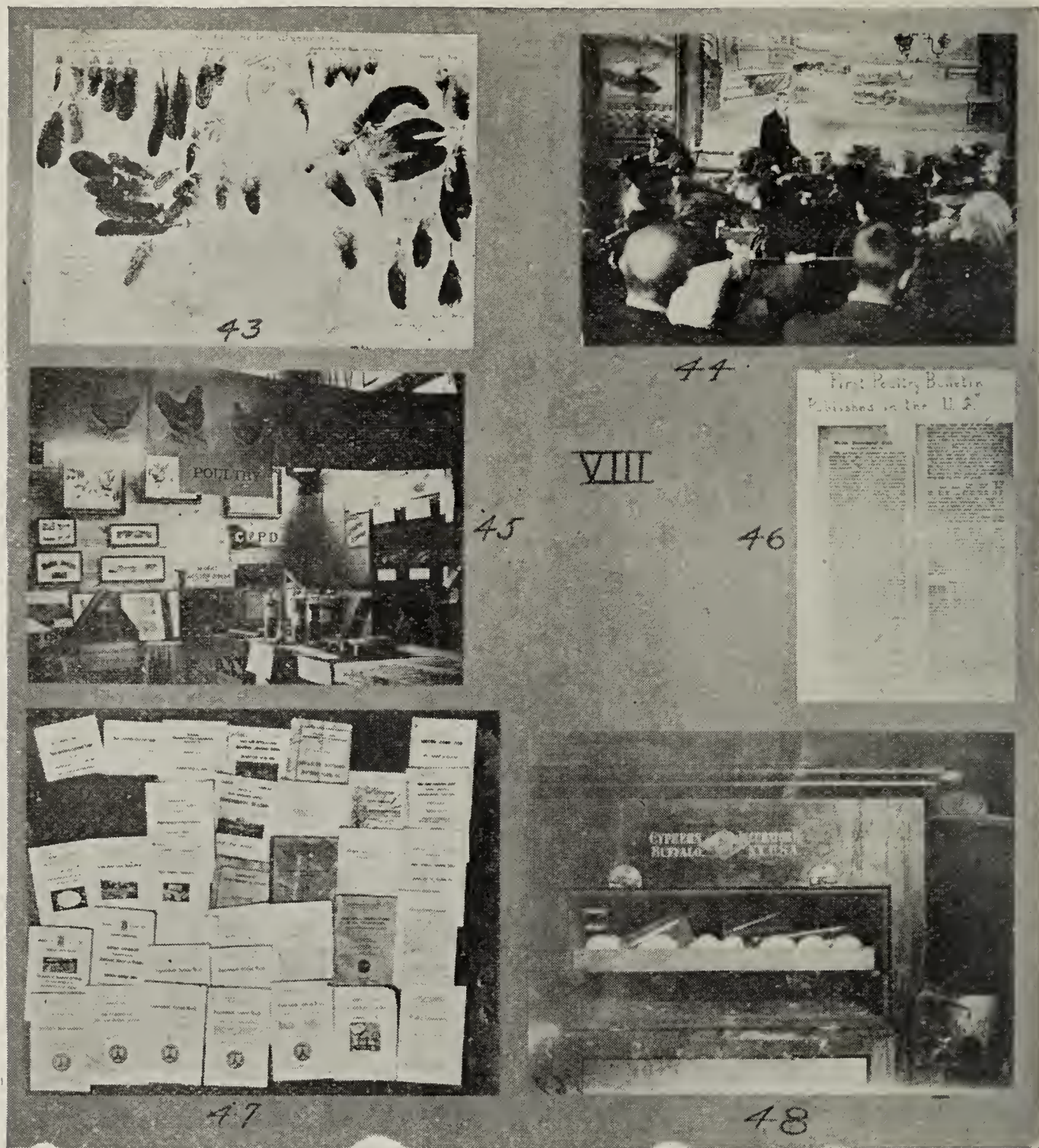
(Fig. 41.) Here they are building a colony house. I like this picture, because it is so characteristic. You can always count on the average American farm boy to be "onto his job."

(Fig. 42.) Here is a collection of eggs, of the different sizes, shapes and colors, with the names of the different breeds that laid them, to be used in the rural school work for the children.



(Fig. 43.) Here are shown the outlines of types of fowls, and the feathers, showing what part the feathers come from, so the children can learn these things for themselves in the rural schools.

(Fig. 44.) This show boys and girls learning public speaking. We have a course the students elect in the Extension Department. They go into the farming communities in the State with one of the instructors, to learn to speak to the farmers' audiences, giving the results of the poultry experiments carried out at the college.



(Fig. 45.) Here is one of the educational exhibits, a small corner only is shown, which shows the egg cases, charts, models, etc. People stop, look at this, and ask questions. They take with them a copy of the catalogue of the educational exhibit, which they can read later.

(Fig. 46.) This shows the first bulletin relating to poultry ever published in the United States. It was published in Maine in 1887. The experiment was carried on by Dr. W. H. Jordan, one of the first directors of an experiment station. He carried out an experiment, feeding wide and narrow rations to fowls. The result of that feeding experiment, carried on in 1885, and published in 1887, is correct in the light of modern experiments in the feeding of other domestic animals.



Last year we had thirty-six bulletins published in the United States and Canada instead of one in 1887. They are shown in Fig. 47.

(Fig. 48.) Here is an incubator with three thermometers; one is located with the bulb half way between the eggs, one upon the eggs, and one hanging just above the eggs. There is not more than an inch difference in height, less than that probably, between the lowest bulb and the highest one. You will see in the next slide (Fig. 49) what the difference is, in actual temper-



ature, reading as shown on the record sheet. We have carried on perhaps half a dozen tests of this sort, with essentially the same results. There is a wide difference, as you will see by the width of these lines. (Fig. 49.) One line running through the page as a medium line marks 103.06. The three fluted curves run below it or above it. The average temperature readings, as you can see, is five or six degrees difference, in the actual temperature reading shown on these three thermometers during the first week.



As the eggs warmed up and developed during the hatch, the temperature readings of the thermometers came together until nearly the end of the hatch, when they were right along side by side.

Let us see what the result was when you ran three incubators, one of them by a thermometer that was placed with the bulb above the eggs, one with the thermometer on the eggs, and one that was down between the eggs, and which in each instance were running 103 degrees. Now note the difference in the hatch (Fig. 50) and yet we followed the directions, running at 103 all through the hatch. The result was simply due to the difference in the way the thermometers were placed.

From fifty eggs we got three chicks where the thermometer was down between the eggs. From fifty eggs we got 23 chicks where the thermometer was on the eggs. From fifty eggs where the thermometer was above the eggs, we brought up thirty chicks. If we had run with either thermometer at a different temperature according to the height of the bulb, we could have secured better hatches, but we simply did not adjust our thermometer to the temperature. We ran them all on the same temperature, 103.06. From this experiment we learn that it is not safe to determine the temperature at which we shall run our incubator until we take into consideration the way the thermometer is placed and the type of machine to be used.

(Fig. 51.) This is a study in type. For three years different students have been working on a comparison of the anatomy of poultry and trying to find out what there is in type, and the waste in dressing, etc. This is only one study of many breeds. We are here comparing the White Leghorn with the Barred Plymouth. The same has been done with Wyandottes and Brahmas, and many others. The fowls are first photographed alive, then cut up into separate parts. The muscles are sliced first lengthwise and then horizontally, examined and photographed. The weights and measurements are all computed. One net result is that we found that if a person were buying 100 pounds of Plymouth Rock or Leghorn, he would get eight pounds more meat from 100 pounds of Plymouth Rock than from 100 pounds of Leghorn.

(Fig. 52.) There are chickens suffering from white diarrhea. It is probably due to a fungus or bacteria. There are six states now carrying on work to try to discover the cause. Thousands of dollars are lost in this country annually through this particular disease. With proper disinfection of incubator, brooder and yards, and rearing on clean ground with healthy stock, we feel that we have nothing to fear from this most troublesome disease.

I see that my time is up, so that as soon as the chairman returns I will have to discontinue the lecture at this point and give the rest of it this afternoon, when the meeting is held for the poultry section.

One of the experiments at Cornell was to compare four months of feeding pullets Fig. 53 shows the amount of feed the average fowl ate. There were eighty fowls in the experiment. We fed one lot on whole grain, wet mash and beef scrap; the next we fed on whole grain, dry mash and beef scrap; the next on whole grain and beef scrap without ground food; the next on whole grain, fed in a hopper, and beef scraps without ground feed. The net results of these experiments the first year was that the twenty hens that received the wet mash gave us a profit of \$21. Those that had the same material fed in a dry mash, where they could help themselves, was \$28. Those getting the whole grain, fed out of hand three times a day without ground feed, showed a profit of \$19. Those fed beef scrap and grain, getting it out of the hopper whenever they wanted it, gave a profit of only \$15.

(Fig. 54.) In this slide is shown two colony houses in which we carried on experiments to determine the difference in temperature and humidity in similar houses, one having a glass window and the other a cloth window. We were surprised to find that the latter averaged less than two degrees colder than the former. It was also very much dryer and the air purer. The egg production and the health of the fowls was better in the house with the cloth windows during the three years' experiments.

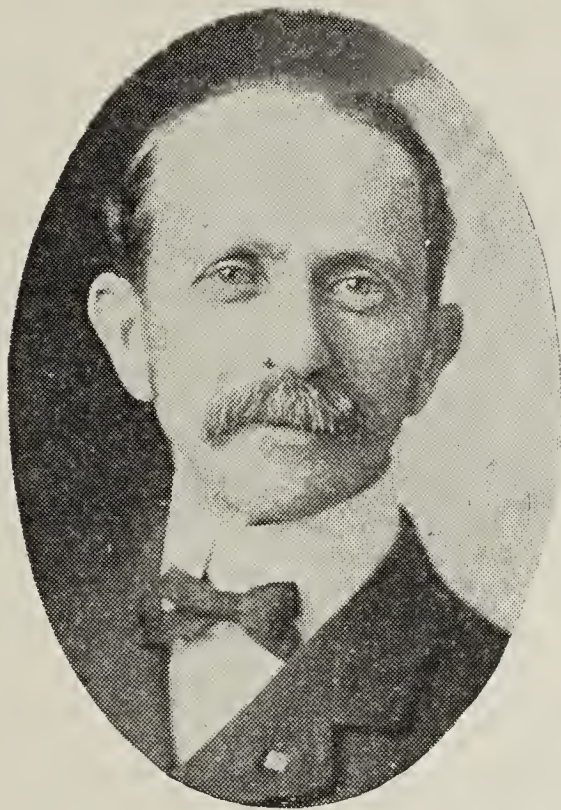


This afternoon we will take up the moulting experiment, the grain experiment, the color feeding experiment, and the experiments of different ways of feeding chickens, and others that I had hoped to take up at this time.

I feel that I have crowded some of the speakers who are to follow on the program and so I will have to close my remarks for the present. I thank you for your attention.

#### POULTRY JUDGING AND BREEDING FROM A STANDPOINT OF GENERAL UTILITY.

MR. CHAIRMAN, LADIES AND GENTLEMEN—I wish to start off by reading a paragraph, from the American Poultry World, from an editorial: "When Secretary of Agriculture Wilson, in his opening address at Washington, (D.



D. T. HEIMLICH.

C.) September 1, 1908, stated that the poultry and egg products of the United States in 1908 amounted to \$700,000,000.00 and that only one crop exceeds it, and that was corn, it made some of the listeners do a lot of thinking. And it will make many more people stop to think before they can realize the immensity of the poultry business of the United States. The value of the poultry products of 1908 exceeds those of 1898 by over \$400,000,000.00, another remarkable feature in the growth of the hen as a national asset.

"And yet the poultry business is really just beginning to find itself, that is, modern methods of hatching, rearing and feeding, and marketing, are rapidly taking the place of the shiftless, slipshod methods of the past. Farmers are beginning to realize the value of producing choice poultry and eggs, and no longer look upon the hen as a vehicle for a little pin money for their wives, but are taking care of the poultry themselves. And still the supply of choice products of poultry and eggs fall short of the demand!"

The foregoing statement as made publicly at the nation's capitol by the Honorable James Wilson, Secretary of Agriculture of the United States, cannot again fail to direct wide-spread attention to the remarkable growth of the poultry industry during the last ten years, and to the high position it now holds in the list of products which each year add hundreds of millions of dollars to the national wealth. Secretary Wilson, with years of faithful and efficient service back of him, is recognized as being both conservative and reliable. His announcement, therefore, may well be accepted as official.



Some three or four years ago Secretary Wilson reported that the poultry and egg products of the United States for the year of 1905, reached a grand total of \$411,027,392.41. The census for 1900 gave the official total as \$280,686,429.00. It was expected that there would be a falling off in the value of poultry and egg products for the year 1908, because that year may be said to have represented "low tide" in the recent industrial and commercial affairs of the United States, on account of the panic of October 1907; but we are now assured by Secretary Wilson that despite the panic and general business depression the combined poultry and egg products for the year of 1908 amounted to \$700,000,000.00.

This is indeed good news. It has been claimed that during 1908 and 1909 there were fewer domestic fowls—chickens, turkeys, ducks and geese in the United States than during the prosperous years of 1905, 1906 and 1907, but it would appear that the reduced numbers, provided the general surmise on this point was correct, has been more than offset by the enhanced value of poultry and egg products during 1908.

The first week in January, following the holiday season, eggs for the table in New York City retailed at 70 cents per dozen. For two months past fresh eggs have retailed in Buffalo, N. Y., a city of secondary importance as a poultry and egg market, at 50 to 60 cents per dozen.

Dressed poultry has been proportionately high, turkeys in the eastern cities retailing during the holidays at 25 to 34 cents per pound. It was not many years ago in western cities of twenty-five to fifty thousand inhabitants, that a five or six pound chicken could be bought entire for 35 cents.

The high price of grain has had much to do with the advance in prices of poultry and eggs, but the demand also has increased, thus adding further to the upward trend in prices. There are no better human foods than poultry and eggs. Milk is the only rival of eggs for table use, and the prices of milk are also soaring these days. Seven and 8 cents per quart are now the prevailing prices in the large cities, whereas 5 cents per quart was the standard price for many years.

The advance in prices of poultry and eggs has kept pace with the increase in the prices of all kinds of meat—quite naturally. It is stated by men who should be in a position to know whereof they speak that the prices of farm products, also of meat, butter, eggs, etc., will never again go back to the old levels; that the increase in population, the increase in wealth per capita and the higher standards of living, not alone in this country but throughout the civilized world have been such that, taking into account the law of supply and demand, we must get used to paying higher prices for all the primary and secondary products of the farm, of the world's entire agricultural area.

It is evident that poultry raisers are getting used to the high prices now being charged for poultry foods. The renewed activity in all branches of the poultry business would seem to indicate this quite clearly. Certain it is that a brisk revival is taking place in the poultry business throughout the United States and Canada. This revival is keeping pace with the return of prosperity in other lines, if prosperity it may be called. President Taft has said that we are living "in an automobile age," meaning, in a broad sense, an extravagant age. No doubt this is true. It is plain that the standards of living are higher now than was the case one, two, five or a dozen decades ago, and this changed condition reaches from the top level of the social strata well down towards the very bottom. People now count as necessities of life many comforts that ten and twenty years ago either did not exist at all or were regarded as luxuries.

In our best judgment the near future looks bright for the poultry business. It can stand high prices of grain as well as any other meat producing industry. It is not a business that can be monopolized—a business for the ordinary farm, the village acre and the city lot. Every by-way and odd corner is being searched these days for low priced poultry foods, for more economical ways of producing poultry and eggs. This is as it should be. Not only is necessity the mother of invention, but the hope of reward has a stimulating effect.



We may well look forward with interest to the census returns for 1910 as regards the poultry and egg products of the United States. The census books are to close June 8, 1910, and if Secretary of Agriculture Wilson was correct in his speech at Washington, D. C., the week of December 7 to 11, 1909, to the effect that the poultry and egg products of 1908 amounted to seven hundred million dollars, what may we reasonably expect for 1910? Here is looking forward with confidence to a time well within the present decade when the United States will be able to boast of a billion dollar poultry industry.

In a slip I clipped from the paper the other day, during the present conditions, in commenting upon the existing situation, it was stated there were eleven million dozen of eggs in cold storage, more than in the previous year, regardless of the effect of the rise in price of grain and in the production of poultry being cut down.

Taking our Asiatic varieties; I do not wish to dwell long on this, only the principal subjects, as the time is limited. With some of our varieties, with the long necks, long legs and sloping backs, the chief claim made for them in their original state when first introduced to the American public was that they can eat corn off of a barrel. (Laughter).

These large specimens Light Brahams (indicating) have almost perfect forms. It is from this strain that many of our new varieties spring and have produced the Columbia-Plymouth Rocks. We have here this morning the cross of the Columbia Plymouth Rocks that the second cross produces—clean legs, and character after the Plymouth Rocks. The specimen, while it is not at its best, shows what can be produced in a new variety when we aim to cross breed and have a definite type in view. New varieties are not objected to if the cross breeding is carried to the goal intended.

This new variety was introduced; (indicating), here we eliminate the pea comb of the Brahma, we eliminate the feather legs. Adopt the character of the Plymouth Rock and produce what we call the Beauty and Utility strain.

Now then, in the matter of production of eggs, this light Brahma hen, that is the grandmother of this chicken, (indicating) laid two hundred and forty-three eggs as a two year old; hence is named by Mrs. R. A. Judy (the originator) as Beauty and Utility Strain, Columbia Plymouth Rock.

There are 132 varieties of standard poultry. This will be one of the new varieties added to our list. It combines the beauty of the old Asiatics that helped to cultivate a taste for more artistic forms, more beautiful colors, and are well worth the attention of the poultry breeders who like contrast of colors.

Nothing has been taught in our schools that offers greater opportunity than the cultivation of poultry. We are only in the A. B. C.'s of this cultivation. Up to 1874 the government has not even kept a record of the poultry industry of the United States. Now we stand second from the forefront in farm husbandry. In the state of Missouri the poultry industry in that state exceeds twenty other farm productions. Calculating that three-fifths of the product is for home consumption, it would bring their total up to \$98,000,000, poultry raised, shipped, and also that consumed at home. That is Missouri. They have shown us.

We should, I believe, stand at the forefront. We have the greatest location and soil surroundings and conditions to produce more poultry than any other state in the Union. We are asking the people at the present time to help the movement onward. We are organizing every district in the State. There are meetings going on today. There are meetings again next week to organize, and in time, from every county we should have an organization that should join the State Association and then coöperate with the University. The State University should be the school where all shall have an opportunity to see and investigate the subject, throughout the fullest operations, and not mere glimpses, so to speak. There should be ten to twenty acres where every variety of the 132 should be shown, and be a center. It can be done so as to be practically self-supporting after a time, from eggs sold for setting, and stock, probably within two years.



That is one of the features that will come to us in the near future. The State Poultry Association is a good thing for every poultry producer in the State. Every man and women breeding a standard variety should belong to this organization.

In the new board we have a set of officers who have taken hold in the right way, and we are going to try to get not less than 2,000 members in this State. We are going to try to have a representative in each county, the superintendent of schools, any county official, or the mayor of a town, and to offer a prize for chickens to be represented from their county or congressional district. Governor Deneen has appointed a board of fifteen, each to represent a congressional district in the State. In other words, Illinois is beginning to wake up and endeavor to do something along the right lines. It will remain to be seen what we will accomplish.

If we have a representative in each county to agitate the matter, what will it mean? It will mean a set of officers who will go before the representatives in the legislature and ask for the things the farmers need, not only in their own localities but in other localities. It will be a general movement toward the up-lift of the poultry industry.

When we got our state appropriation years ago, we were met with this statement: "It is nonsense to ask for an appropriation; you don't want to use it in that way, you just want to get this money from the State." However, we obtained an appropriation. There is now one thousand dollars appropriated each year for the association.

Last year we wanted to get the people out and did not. Why? We had not advertised it. Now, however, we have had bulletins, and advertised, and circulated advertisements, so we are looking for greater things at our next meeting the first week in January 1911. This exhibit will be free to the public.

Take the subject of poultry talks in Illinois. I have heard of but three or four men who have been invited to speak on the subject at poultry exhibits. We must change this condition. We have got to do institute work. Those 152 men who carry licenses will have to wake up and do something besides taking their money and start for the next show with it. The next move will be to have poultry judges devote their time to poultry and the associations that employ them. The associations as a rule are willing to pay a good price for good men, but many don't want to take time to talk to the men and women, the boys and girls, and instruct them. How are we going to have such instruction disseminated?

We need a school where these young men who have natural ability, or ability they can cultivate, who have natural talents, a love for animals, who, in a word, "take" to this work, can become competent poultry judges. How are we going to get them? There is no provision made. We have to create a sentiment for that. These young men, the future poultry judges, must be educated in a practical and scientific work, as it should be done. It is not enough for a man here and there to dig out the information for himself, but provision should be made for the scientific study.

In the central west here, five or six judges got together. Then comes another along to dissarrange everything by ridicule. Now then, if a man has no faith in his own work, can he be competent to teach anybody? That is my position. It is that element that is too prevalent among the poultry judges.

There were fifty-six men appointed two years ago to lecture and talk on this subject. I have heard of Professor Rice and two or three others, who have spoken on the subject publicly.

I might read a lot of teachings on this subject, and the branches chosen by no two would be the same. It shows what can be done. It is that class of men we want to continue the work, and advance the progress of this aid to man's sustenance, so long overlooked, yet so important among the material things, by which, alone, we may, live, for the aims that make our lives worth while.

I am often asked, are there any large poultry plants making a success of poultry raising? Yes, and more every year. When I was in California last



November I met a gentleman who formerly was high in official life in Colorado. He was tired of public life and decided to move with his family to California and invest in White Leghorns. It was a peculiar country there. Those of you who have been to San Jose in Santa Clara county, California, know it is the greatest country in the world for fruit. Two years ago he had seven hundred and fifty Leghorns, and from each he realized over and above expenses two dollars per head. How did he do it? His business training was good and he had an account of every detail and the cost of everything; care and good management did it.

In another case a banker went to Colorado Springs eight years ago. He leased five acres and used two acres for poultry. He had nine hundred White Leghorns in the months of April, May and June. In 1905 he sold eleven hundred dollars' worth of eggs, most of them at regular market price.

What these men can do, others can do; not in the first year, but in two or three years. This same man adopted another plan since then. He keeps his pullets one year and sells them in the market. He does not keep a male on the place. He gets the eggs and is nothing out, only the feed, time, and attention to the stock.

Now this is a line of work that you or any one else can do and make a success. You can take anyone of these 132 varieties and, by careful selection, you can establish and maintain a flock that will pay you better and greater profits than anything you can invest in. There is money in the poultry business. We all know of the man who said he knew there was money in the poultry business, because he had put in five thousand dollars and never got a cent out of it. (Laughter.)

Question—What about crossing different kinds of standard poultry?

Answer—There is nothing to cross-breeding, because you are apt to reduce your grade in breeding unless you give it more attention, and continually use only high quality breeding and laying stock to keep up the flock to a high standard.

We don't want to look at a poor chicken or a poor animal of any kind, and improvement can only come by careful selection from the best produced. People breeding poor stock to standard stock, by that method reduce the higher breed of stock. There is a lot of skill required in the rearing of chickens and breeding of chickens.

Education for skill has a right to demand more time than a single day or week meeting. You must have that education for poultry raising.

It belongs in our high schools, every one of which should have a small pen of chickens to offer experiments to pupils. I think the high school can afford one, and teach the pupils a little about poultry culture. Take a boy or a girl who has interest in this and get him or her to come to the summer school at the University for six or eight weeks. Suppose we can only get three or four from each school in the State interested in this work, in which we are giving instructions; you will be surprised at the results in the community.

I think this meeting has done some good, and you will appreciate the interest taken. At the University, as I said yesterday, the poultry men themselves have not pushed it as they ought to. The University was, last year, a much larger school, and we are waiting for the people to take hold of it in the right way.

You can get much information in bulletin form. You have only to say "Please send us all the information relating to poultry raising." If you will write to different universities asking for the bulletins, you will get them and they will convey valuable information to you. The Rhode Island Station has made a specialty of that work. Any amount of information is in the bulletins, and they are for that purpose. They are public bulletins for you.

#### ILLINOIS AND THE POULTRY INTEREST—WHAT OUGHT TO BE DONE.

(Miss Kate Maxey, Curran, Illinois.)

MR. CHAIRMAN, LADIES AND GENTLEMEN—The topic which I am asked to discuss is one of great importance to the people of Illinois, who are in-



interested in poultry—and who are not—either as a producer or consumer. Formerly the “poultry crank,” as our admiring friends please to call us, was supposed to be engaged in a very little business. Now the poultry industry is the biggest little business on earth. It has come to the front, not by a slow and steady growth, but by leaps and bounds, and we are no longer pursued by the phantom that the business will be overdone. One of the most interesting facts is that one can begin to raise poultry on very small capital, with experience and equipment, and develop the business gradually, as the profits warrant.

Poultry yields larger profits for time and money invested than any other undertaking, and conditions were never so favorable for success in the business as now, to those who understand its management and give it full time and attention. The prediction of unheard of prices for this winter have certainly been fulfilled, in fact, they have been almost prohibitive for people of moderate means and large families.

The census of 1899 gives the total value of poultry products at that time as \$281,178,035. In 1909 Secretary Wilson credits poultry products with value of \$625,000,000. In ten years of time an increase of 222 per cent is shown. We are informed that the poultry business of this State last year was worth about \$40,000,000.

Illinois ranks second as to the value of her poultry products, only Iowa leading and Missouri being a dangerous rival.

While the production is increasing rapidly, that the demand is keeping pace with the supply is evidenced by the great increase in the prices of poultry and eggs. It is a fact that both poultry and eggs are imported to this country. In a country the size of ours, the conditions of which are such that the industry is capable of indefinite expansion, the poultry man and the farmer should certainly be able to supply the demand.

If any one doubts the importance of the poultry industry, let him study the question, observe the large business being done by railroad and express companies, the quantities of dressed poultry and eggs for sale in the markets, the manufacturies of paraphernalia incident to the poultry business. In addition to the sum actually realized from the sale of market poultry and eggs, there is an immense amount of money involved in other ways. It is estimated that the manufacturers of incubators and brooders do a two million dollar business annually. Large sums are spent for advertising for fancy breeding stock and high priced eggs for hatching. A large number of well attended shows are held each year at considerable expense.

There are about sixty poultry publications in the United States; nine of the best of these are published in Illinois with an aggregate circulation of 300,000, a larger circulation than the combined number published outside the State can boast.

The people of Illinois are among the most progressive poultry keepers in this country. All over the State are many farmers raising pure bred stocks, yet whenever any of our young people wish to make a special study of poultry work, they are compelled to seek instruction in some other state, perhaps crowding out students who have the first right there as natives of that state. Because of the practical work which is necessary, if the student really learns the poultry business, the number of students is often limited, as many states are more or less hampered by inadequate equipment and lack of funds.

There are now in the United States and Canada thirty-four states and provinces where some sort of investigation work is being done in poultry. There are sixty-five teaching poultry, and forty-two doing research work. Illinois stands almost alone in ignoring this branch of rural industry.

A splendid work has been done in some states, while others have just made a good beginning. In 1907 there were 879, in 1908, 1,369, and in 1909, 2,985, making a total of 6,102 persons taking some sort of poultry work. A few states have so far been able to provide for only a short winter course from



two to twelve weeks, where the course is designed not to turn out finished poultry men in so short a time, but to give a glimpse into the possibilities of the poultry business, to start a foundation upon which to build a successful career. These courses are practical and a great many subjects are taught and some experimental work is included, the amount depending upon the length of the course. It is a significant fact that the majority of states which give a two, three or four-year course also include the short course. Many who can afford neither the time or money for even a year's work can take advantage of the short courses, which are especially designed to help just such persons. Many colleges have complete courses where the student can specialize upon any part of the work he chooses.

Some of the subjects taught in a first class poultry department are: Principles of breeding, mating for exhibition utility purposes, natural and artificial incubation and brooding, general care, fattening and marketing, chemistry of food, foods and feeding, poultry building, location, construction and arrangement, furnishings, sanitation, diseases and parasites. Generally the instructors in the poultry department lecture at farmers' and poultry institutes over the State. They also carry on a large correspondence with poultry people in the State, and give desired information to those who visit the station. Graduates of these departments are in great demand as managers of poultry farms and to take charge of poultry departments and experiment stations. The supply is limited. In a few states specific appropriations are made to carry on the instruction and investigation at the State university. In others the poultry department shares in appropriations for the College of Agriculture.

One of the colleges which is doing very practical work for poultry is located at Guelph, Ontario. The question that Prof. Graham of that college has always before him is, "How can the farmers do better with poultry? How can they raise more and better poultry with increased profits?" It is the only college, I believe, where all who take the agricultural work must take the poultry work. The station is visited each year by 30,000 to 35,000 farmers. Ninety per cent of these farmers want to know about eggs and meat and only ten per cent are interested in fancy poultry. They have been raising chicks in corn fields and find they get better results at less cost than when grown on sod. They have experimented with crate fattened fowls and find that fifteen cents may be added to the market price of each fowl. They assert that an increase of one egg per hen in the province of Ontario would net \$200,000.00 annually, with eggs at twenty cents per dozen. This sum would more than support the agricultural college. Connecticut is asking for \$25,000 appropriation and expects no difficulty in getting it, as the poultry industry is very important in that state.

Michigan writes: "It is the aim in all our poultry courses to make them as practical as possible, so that the student who takes them will be familiar with the problems which he will meet when working for himself or on the poultry farm." They have sent out one or two bulletins among the farmers. Representatives of the college do judging work of poultry exhibits at fall fairs.

Wisconsin will spend \$6,000 for building this year and next.

Iowa has a well equipped farm of twenty acres. They hope soon to have a poultry lecturer who will give his whole time to work of that sort. They hope for a large appropriation next year.

Ohio has a bill now before the legislature asking for \$10,000 to establish a poultry plant at the university.

New York is asking the legislature for \$90,000 for a poultry building. Later they will need \$20,000 for equipment. They now have capacity for raising 5,000 chickens and wintering 1,500 head of poultry. Both gross and net income have steadily increased. The experiment station is doing splendid work which has to do with different phases of constitution and vigor. The office work and correspondence is very heavy. They have interesting plans for further work.



Maine published the first poultry bulletin in 1887, 180 to date. All agricultural students must take a stated amount of poultry work. The poultry department has a complete up-to-date equipment, equal to any institution of its kind in the country. The experimental department is largely under the control of the federal department.

Pennsylvania College of Agriculture conducts a school of correspondence in thirty-two subjects, one of which is poultry husbandry. A certificate is issued to all who pass satisfactory examinations and pay a small fee.

Indiana is just starting poultry work. They receive \$5,000 per annum.

Minnesota has \$5,000 for 1909 and \$2,500 for 1910-1911. They held a poultry institution in connection with the state show this year.

Massachusetts has been doing experimental work for fifteen years. The first poultry instruction will be given this year—a four weeks' course.

Missouri has no poultry course, but hopes to establish one within the next two years. They held a three weeks' course this year. The state recently received a \$10,000 appropriation, this money to be in charge of a State Poultry Board. The secretary of this board devotes his whole time to the work and is paid \$1,200 per annum. The Missouri State show held recently is said to have been the largest and best managed show held in the United States.

Colorado has \$5,000 with which to establish a poultry department, and is slowly making a start. They are doing effective work in institutes and short courses. They believe that Colorado possesses many advantages to poultry keepers, as they have unlimited market and are encouraging inquiries both in and out of the state to consider their advantages.

A few years ago the sum of \$25 was appropriated to start the poultry work at the Kansas college. The department has grown each year since. In February, 1908, a two years' laying contest was ended, in which were compared all the different varieties. The data as to cost and ways of feeding is valuable. The instruction has been given in a general way only, the main idea being to stimulate the raising of poultry as a side issue on the farm and to teach the students how to handle some of the simple problems of the business. The seniors study every phase of poultry husbandry, and are given practical work besides, just as far as the limited means will permit.

Rhode Island is doing valuable work in the study of diseases, especially of black head in turkeys. The records of the American Poultry Association tell us that for one dollar spent for instruction and investigation in poultry in the United States there are seven dollars spent in horticulture, and six dollars spent in dairy work.

From the government reports we find that the income from poultry, as compared with horticulture, as at the ratio of 10 to 13, while that between the poultry and dairy is 10 to 17. We find that for \$1.00 expended in Illinois for dairy work, \$456 is produced by the State; for horticulture, \$1.00 expended for instruction and experiment, \$435 produced by the State; for poultry no money expended for either, \$40,000,000 produced by the State. The legislature appropriates \$1,000 annually to the State Poultry Association. That Association is working for a 5,000 bird exhibit and for 5,000 people attendance for 1911. The plan for a State Poultry Board, one member from each congressional district to be appointed by the Governor, these members to look after the interest of the show in their own district. It is also proposed to have a poultry institute in connection with the next show.

#### SOME RESULTS OF RECENT INVESTIGATIONS IN POULTRY HUSBANDRY.

(By James E. Rice, Professor of Poultry Husbandry, New York State College of Agriculture at Cornell University, Ithaca, N. Y., before the Poultry Sectional Meeting of the Illinois Farmers' Institute at Edwardsville, Ill., February 24, 1910.)

FRIENDS AND FELLOW-POULTRYMEN—In the time which remains before I am obliged to catch my train it will be impossible for me to cover the field which



the importance of this subject ordinarily would demand. I will, therefore, show only the more important slides and make a brief statement explaining the nature of the problem and its direct application to our needs as poultrymen.

First, we will take up a consideration of some of the points in successful egg production. The first has to do with the physical condition of the fowl as influencing the production of eggs. It is necessary for us to study the condition of the hen as well as the composition of the ration. Experienced poultrymen have long known that the best feeders are close observers of the



way their fowls act and eat, which has led us to make some careful observations to learn the physical condition of the fowl best suited to egg production. What I shall say may surprise you, but I leave it with you to verify my observations for yourselves, and draw your own conclusions. It has become more and more apparent, as we have observed fowls when they have been doing their best laying, that they are heavy feeders and that they must have all they can eat, digest and assimilate if they are to continue to give us their best production. The old question therefore arises if we give hens all they want to eat of the right kind of food, will they not become too fat? Our



observations indicate that we have been inclined to place too much emphasis on the danger of fowls becoming too fat. This was especially emphasized a number of years ago when killing a very fat hen. We found this hen to be so exceedingly fat that she apparently was almost in a condition of fatty degeneration. The particular fowl in question is shown in figures 55 and 56 alive and dressed. When this fowl was opened she was found to be in perfect laying condition with an egg hard shelled and ready to be laid and any quantity of yolks in advanced stages of development. Since then I have seen many similar instances. On one occasion, when we were killing a large number of fowls, the fact that the hens that were found to be laying at the time they were killed were the fattest hens, led us to make a careful study of this question, with the result that we found that almost without exception the hens that were laying were the fattest and the hens that were not laying were the leanest. In fact, in no instances did we find that a lean hen was laying at the time she was killed. Figure 57 shows the three fattest hens and the three leanest hens side by side. Under each of these hens are placed the liver, gizzard and egg organs. In the three fattest hens eggs were fully formed with hard shells. In the three leanest hens the egg organs were dormant and under the most favorable conditions could not have laid for a number of weeks.

In Fig. 58 we are able to get a possible reason why hens have surplus fat in their bodies if they are to lay. It shows the egg organs of a fowl consisting of the ovary, where the yolk of the egg is developed, and the oviduct where the white is deposited, the shell membrane is laid on and the shell is made. The fact that the first part of the egg to be made is the yolk and that the yolk consists of more than half fat, would lead us to assume that the hen cannot make the first part of her egg unless she has surplus fat in her body. The fact that fat is energy and that only the hen that is in such physical condition that her bodily wants, so far as fat is concerned, have been supplied and she therefore, has surplus energy to store up against a time of need, would indicate that she is then in her best laying condition. Moreover, we have the best of evidence for believing that the fat in the yolk may be utilized by a fowl to supply the needs of the body, if, for any reason, should be withheld, so that she would have need for this material to supply heat and energy. In other words, that hens in full laying condition may cease to lay and have the fat in the yolk re-absorbed into the body if they become poor and need the fat.

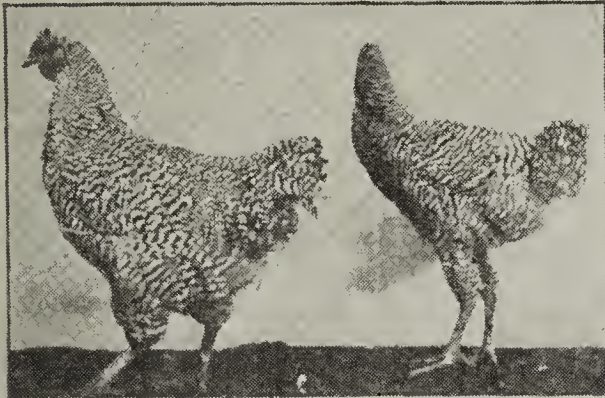
We can get abundant verification of the reasonableness of the assumption that a hen in the best laying condition carries considerable surplus fat in her body in our observation of other domestic animals. It is a well-known principle in animal breeding that a condition of pregnancy is accompanied by a storing up of fat in order to meet the demands of nature in nourishing the offspring. In a very natural sense the hen, in her laying condition, may be compared to the pregnant mammal.

A more positive proof, however, that the best laying condition carries with it a condition of fatness, is found in the correlation in the weight of the fowl and her product. We have made a large number of observations in which we have found that fowls increase their consumption of food for a number of days before they begin to lay; that they increase their weight very soon after they increase the consumption of food and that they lay the best when they have reached their maximum weight; that they decline in weight as they decline in production. In other words, appetite is directly dependent upon production.

How we must feed our fowls in order that they may have surplus fat in their bodies to lay well without becoming too fat and break down with fatty degeneration, is an exceedingly difficult problem to solve. This is primarily true because fowls must be fed in flocks instead of individually. We must, therefore, take our chances on some fowls becoming too lazy and fat in order that the others may have enough food to meet their bodily requirements for the best production. This means careful grading of the flocks from time to



time to weed out the overfat hens though they may, at the time, be laying, and that we give all of the fowls, each day, all that they can possibly eat of the right kinds of food and at least once a day become hungry, as an



Strong **61** Weak  
A. Barred Plymouth Rock



Strong **62** Weak  
B. White Plymouth Rock

~ XI. ~



Weak **63** Strong  
C. White Leghorn



Weak **64** Strong  
D. Silver Spangled Hamburg



Weak **65** Strong  
E. Buff Plymouth Rock



Strong **66** Weak  
F. Buff Orpington

~~Figures~~—A, B, C, D, E and F. To show contrast in constitutional vigor in cockerels of six varieties.

indication that they have made good use of the food which has been given them. Plenty of exercise tends to keep the body strong and healthy. Hence, fowls should be encouraged to work as much as possible in a deep litter of



straw in the open air during the winter and have as wide a range as possible during the summer. As between the two dangers, it is better for us to take our chances on the fowls getting too fat, than it is in restricting the amount of food to keep them hungry to avoid overfatness. If fowls are active and are hungry once each day, the danger of overfatness is not great.

A problem which has caused considerable discussion among poultrymen and about which there is a good deal of difference of opinion at the present time, is in regard to the wisdom of undertaking to force fowls to molt earlier in the season than they ordinarily would be expected to do. In order to throw some light on this problem we carried out a series of experiments with six flocks of fowls aggregating about 240 individuals of different ages. In one experiment one-year-olds were used; in another two-year-olds and in another three-year-old fowls. All were White Leghorns. All were fed essentially the same rations and were kept, for the most part, under similar conditions. About one-half of the fowls of each of the three ages were fed during the entire year as well as possible for egg production without regard to the molt. The other half (about 120 fowls) were given restricted rations for about four weeks; that is to say, while they were fed the same kind of food as the other fowls in the experiment, the amount which was given was reduced for about four weeks to about one-third to one-half of the usual rations. By this means egg production almost ceased and the fowls averaged to lose about one-half a pound apiece in weight. After the starvation period they were fed liberally on the same rations and careful observations were taken each week of each fowl in order to determine the progress of the molt. For this purpose each of the six flocks of fowls was dipped in a different colored diamond dye. By this means the old feathers and the new could be distinguished. It was found that while the starvation process slightly hastened the molt, the fowls did not recover materially sooner from it and did not lay as well during the remainder of the year. It was found that the 120 hens that were starved paid a profit of 25 per cent less than those that were well fed during the molting season.

Figures 59 and 60 show the method of dipping the fowls in the diamond dyes and hen No. 61 in a molting condition. This hen was the best of all the trap nested hens in the experiment. She is alluded to here because of the fact that she molted so late. The molt did not occur until the 28th day of November, at which time this photograph was taken. She laid 213 eggs in the preceding nine months. Apparently the reason that she did not molt was because she continued to lay during the season when hens usually molt. A careful inspection of the records showed that, as a rule, the hens that molted latest were the best producers. This was simply because of the fact that they had an inherited tendency to lay, which postponed their molting period. If hen No. 61 had been in one of the flocks that were starved, she probably would have ceased to lay at that time and we would have failed to observe the principle that the best hens molted last. It is interesting to observe that in no instance did a hen continue to lay and molt at the same time. A number of hens began to molt before they ceased to lay and others might begin to lay before they completed their molt. As a rule, it took about 90 days from the time the fowl began to shed until she had grown all her new feathers.

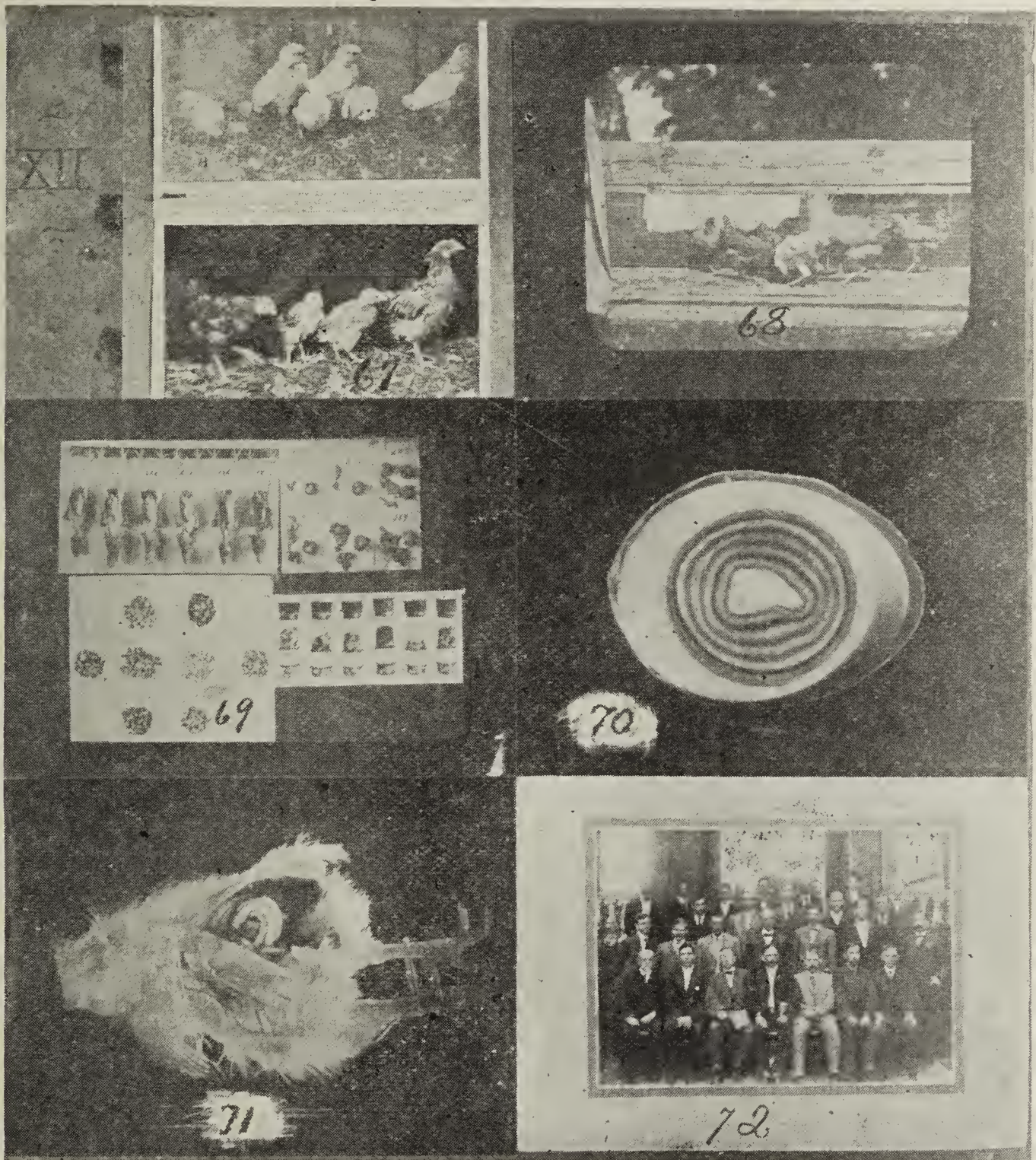
The lesson which we gain from the above experiment would lead us to believe that it is wise for us to feed hens as well as we can during the entire year and especially to see that they are supplied, during the molting season, with an abundance of protein feed rich in nitrogen to grow feathers. At this time, particularly, meat, clover, oil meal, etc., should be fed. It leads us to the very practical conclusion also that it is mightily good business to let a hen lay when she wants to and not undertake to stop egg production and then taking our chances on starting it again later in the season when conditions are all unfavorable.

We are also led to save, rather than kill, the hens that molt last and who also show that they have good constitutional vigor. They are likely to be our best producers. Because they have continued to molt late is the best



evidence that they probably will rest for several months during the winter, which will make them all the more valuable for breeders during the following spring.

Without doubt the most important factor in successful poultry farming is to improve and to maintain strong constitutional vigor in a flock. The tendency of modern, intensive poultry farming has been to reduce the natural vitality of the race of the domestic fowl and to shorten its life. A large number of factors have contributed to this result. Among these are the close confinement of the fowl on limited areas during the summer and in small



close pens during the winter, together with heavy feeding on concentrated rich foods with the hope of stimulating egg production. In our endeavor to keep fowls comfortable during cold weather they have been so closely confined in vitiated, sultry air that they have suffered more from breathing impure air than they have suffered from the cold or frosted combs. The keeping of fowls in large flocks has frequently caused the attendant to overlook some that are weak, which because of their being jostled by the strong, have become weaker. These perhaps have survived until the breeding season when, as is the custom on many farms, there has been no careful selection



of the breeding stock. As a result eggs from this weak stock have been used for hatching because if they lay at all, it will be during the most favorable months of the year, March, April and May, when the hatching and rearing is done. In many instances sufficient care has not been taken to kill weak chickens at the time of hatching or later, which has, in some instances had a tendency to increase the mortality of the laying flock. Whatever the cause of low vitality, the fact remains that in many flocks fowls differ in their robustness and their ability to stand up under heavy feeding. This is true not only of certain strains or families, but of certain individuals within a common strain or family. So true is this that it is becoming more important to know the native vigor of the flock or of individuals within the flock, than to know the name of the variety.

It is, therefore, pertinent for us to inquire whether or not we can recognize constitutional vigor from weakness when we see it, either in a chicken or in a mature fowl. If so, how can we detect it and eliminate it from our flocks. We have been making a number of experiments at the Cornell Station to determine this point. We are perfectly certain that there are physical differences, which, if any one will study fowls of high and low vitality, they can quickly detect.

Figures 61, 62, 63, 64, 65, 66 and 67 show various types of fowls. They are both strong and weak types and show clearly, by their shape and attitude, their relative constitutional vigor. Generally, it may be said that a fowl that is of the narrow, slender body is of weaker vitality than a fowl of the same variety and age that has a short, thick, stocky body. The head should be short and broad with a well-curved, heavy beak, with large, bright-red appendage and with a clear, round, bright eye that stands out full and prominent. The drooping eyelid and dull sunken eye, the long, flat beak and crow head, the small, pale comb, indicate low vitality. The legs should be set wide apart in order to give body room to carry the digestive tract and to furnish the machinery for heavy digestion and large production. The lustre of the plumage, as well as the quantity of feathers and rapidity of feathering indicate constitutional vigor when the rule is applied to chickens of the same age and variety. A short, heavy shank is one of the most apparent features of a strong body and good digestion. The way the fowl crows and sings or cackles, depending upon the sex, indicates it has good health, as does also the way it eats. Fowls that get off the perches first in the morning and go to roost the last at night, generally have the strongest constitutions and are in the best laying condition, because their actions indicate that they are hungry and hence possess good health.

Selections should always be made of the breeding stock in the fall of the year, at which time only the best fowls of the strongest constitution are likely to be laying. It is found, also, that these fowls are the most prolific. A careful study of trap nested hens indicates that the poorest hens lay only during the most favorable season, while the best producers not only lay as well or better during this season, but they also lay during the unfavorable time of the year—the fall and winter. A person who will select his breeders on a basis of constitutional vigor during the fall and continue to eliminate will find it possible to increase the number of eggs laid per fowl and vastly reduce the mortality in the flock. Mere selection of constitutionally strong fowls, however, will not insure success. We must at the same time, eliminate the other conditions which tend to lower the vitality.

The following table gives the results of the first year experiments in comparing fowls of high and low vitality. It will be seen in the right hand column what the gain or loss is between the three strong flocks and the three weak flocks. Pens 78 and 79 compare high and low vitality chickens selected when young. Pens 76 and 75 were selected in the fall when placed in winter quarters. The same is true of pens 8 and 10.



FINANCIAL STATEMENT PER HEN BASIS.

|                                         | White Leghorn, spring, selection weak—Pen 79 | White Leghorn, spring, selection weak—Pen 79 | White Leghorn, fall, selection strong—Pen 76. | White Leghorn, fall, selection weak—Pen 75.. | Barred Plymouth Rock, fall, selection strong—Pen 8 ..... | Barred Plymouth Rock, fall, selection weak—Pen 10 ..... | Average, three flocks, strong—Pens 8, 76, 78.. | Average, three flocks, weak—Pens 10, 75, 79.. | Difference..... |
|-----------------------------------------|----------------------------------------------|----------------------------------------------|-----------------------------------------------|----------------------------------------------|----------------------------------------------------------|---------------------------------------------------------|------------------------------------------------|-----------------------------------------------|-----------------|
| Number of eggs per hen .....            | 128.5                                        | 131.4                                        | 120.4                                         | 92.7                                         | 125.4                                                    | 114.4                                                   | 124.7                                          | 112.8                                         | 11.9            |
| Value eggs per hen.....                 | \$2 95                                       | \$3.05                                       | \$2 80                                        | \$1 95                                       | \$3 01                                                   | \$2 74                                                  | \$2 92                                         | \$2 58                                        | \$0 34          |
| Balance profit per hen .....            | 1 81                                         | 1 63                                         | 1 65                                          | 74                                           | 1 71                                                     | 1 57                                                    | 1 72                                           | 1 32                                          | 40              |
| Per cent mortality .....                | .....                                        | 16.87                                        | 3.17                                          | 31.52                                        | 12.54                                                    | 8.34                                                    | 6.9                                            | 18.91                                         | .....           |
| Per cent fertility .....                | 88.1                                         | 81.7                                         | 86.2                                          | 69.0                                         | 78.8                                                     | 69.6                                                    | 85.1                                           | 75.9                                          | 9.2             |
| Per cent hatching power .....           | 67.3                                         | 68.1                                         | 63.4                                          | 57.8                                         | 52.1                                                     | 45.5                                                    | 62.4                                           | 61.0                                          | 1.4             |
| Average weight in pounds, pullets saved | 3.00                                         | 3.05                                         | 3 07                                          | 2.45                                         | 4.53                                                     | 3.48                                                    | 3.53                                           | 2.99                                          | .54             |

The fact that the importance of grit is not wholly appreciated is indicated in the results which we have secured in a number of experiments which we have tried in order to determine its value. Five separate experiments have been carried on along this line, the net results of which are that grit is necessary not only to furnish lime to make the egg shell, but also to serve as a grinding or crushing agent. Where fowls were fed on Mico Cubical Grit for eleven months, without oyster shells or bone or lime in any other form than in the grain rations which were fed, the hens ate practically all of their eggs from the very first ones that they laid as pullets. During this time they were in poor physical condition and apparently laid only a few eggs, which were inclined to be soft shelled. The total loss on these fowls during the eleven months of the experiment was over 70 cents per hen, without considering the labor. Six of these hens were removed at the close of the experiment and were fed, for several months, on the same kind of grit and same rations, with the exception that bone and oyster shell were given. As a result, the hens ceased to eat their eggs, improved in health and were in excellent laying condition when they were killed, as indicated in Figure 68. Figure 69 shows the hens eating eggs before they had been fed oyster shell. In another experiment one flock of hens was fed Mico Spar Cubical Grit and oyster shell while another flock of the same variety was fed the same materials in the form of a fine powder. In each instance, therefore, the fowls had a similar mineral supply but one flock had natural material and the other did not. There was a very decided gain in egg production in case of the flock that had the material with which to grind their feed, indicating very clearly that fowls need not only mineral matter but also some hard crushing agent with which to reduce the food in the gizzard.

Time will only permit one or two more slides. These will have to do with some experimental work which our Professor Rogers has been carrying on in the feeding of color pigments to determine changes which take place in the growth of fowls, and especially the development of the egg. Figure 70 shows the yolk of the egg that has been cut in two. You will notice the concentric rings of different colors, the yellow and red rings alternating. The fowl that laid this egg had been fed a red aniline dye every four days. This dye is known as Sudan III. It was brought to our attention by Dr. Oscar Riddle of Chicago University, who used it in some of his feeding experiments with hens. It has the peculiar quality of coloring the fat that a fowl suggests while this pigment is in the body, but does not color the fat that had been assimilated before the red pigment was fed. Hence, by feeding Sudan III at different intervals, one can tell by the red rings and the yellow rings of fat what has taken place in the time intervening between



the feedings. Figure 71 shows a chicken that was hatched from an egg that had been laid by a hen fed Sudan III. The pink colored fat in the body of the chick indicates that the colored fat of the yolk had been transmitted over into the body fat of the chicken. This gives us a fine illustration of the fact that a chicken may be born fat or lean, depending upon the material within the egg and the method of incubation, which enable the chicken to grow normally within the egg.

Figure 72 is the last slide. It shows a picture of the instructors and investigators in poultry husbandry in the United States and Canada who assembled two years ago at Ithaca, N. Y., and organized for more effective work. This will impress you with the fact that poultry husbandry, at last, is assuming the importance of a profession. It has always been a large and important industry. It is now becoming a systematized organized industry worthy of the thought and attention of thinking men and women.

With the hope that some of the points which I have endeavored to bring out in the short space of time which we have had for this lantern slide lecture will be sufficient to convince you of the importance of having a poultry department established in connection with your agricultural college and experiment station, where not only these but many other problems may be investigated, and with the wish and hope that you and other wide awake poultrymen in this great State of Illinois, will rise to the emergency and organize yourselves into a strong local association which may be welded together in a strong Illinois State Branch of the American Poultry Association so that you may work as a unit for the better development of poultry husbandry in the State, I bid you good-bye and hope to have the pleasure of some day meeting with you again.

## IS THERE A PLACE FOR INSTRUCTION IN POULTRY HUSBANDRY IN THE PUBLIC SCHOOLS.

(Prof. D. O. Barto.)

MR. CHAIRMAN, LADIES AND GENTLEMEN: A problem that the College of Agriculture of our State University has been working upon for some time is to determine what work in agriculture is best suited to the conditions of public school teaching and can be made of greatest service to the communities where it is introduced.

Up to the present year the agricultural work that has been planned for the schools to undertake has dealt almost exclusively with studies of soils and crops. This is important and valuable work and many of our schools are now teaching these subjects very successfully and the university has recognized the educational value of these studies and offers credit for them as entrance preparatory work on the same basis as is given for any other school work.

But raising and feeding and breeding animals for food and clothing and other service is one of the most important fields of agriculture and certainly one in which there is as great need of the knowledge and use of the principles of science and of careful training in proper methods as is found in any line of agricultural work.

Moreover, animal life has especial interest and attraction for most young people, and presents so many sides for valuable scientific study and observation that there has seemed to be strong claims for adding courses in animal studies to the agricultural work in the public schools.

The principal obstacle that has stood in the way of doing this has been the difficulty of providing schools with proper material for the work and arranging for taking care of it both during the school year and the long vacation. In some communities it is possible to do considerable of this work, making use of the farm animals owned in the immediate vicinity, but even in the most favorable situations this has serious limitations. For satisfactory work in teaching and investigation the school needs to own and control its material, and this is obviously out of the question with most schools in the case of the larger farm animals, such as horses and cattle, or even with sheep and hogs.



However, it was my good fortune several years ago to become interested in raising and breeding poultry and that interest has remained and grown with me ever since. I had always cared for farm animals more than for any other kind of work, and my pleasantest boyhood associations on the farm are connected with handling and raising horses and sheep. When I took up the work of poultry culture I found there was quite as much opportunity for developing enthusiasm and scientific interest with this branch of animal industry as in the management of other kinds of stock and that there were some decided advantages in the work with chickens.

Poultry products are staple articles of food. Every house is directly interested in the quality and cost of these products. There is no other article of food that so many families may produce for themselves at their own home, and there is scarcely any other food produced whose value and quality so largely depend upon freshness, soundness and cleanliness of food used in producing it and healthfulness of the stock from which it is obtained.

For educational purposes poultry work possesses great advantages because it is work that is continuous throughout the year, presenting different



PROF. D. O. BARTO.

phases and problems with each season. It is also work in which results may be obtained in a few months' time and sufficiently large numbers may be handled to make experiments of some definite value. Moreover, none of the necessary work in connection with it is too difficult or too expensive for young people or women to undertake, and whatever experiments arouse interest in the school may be repeated in many homes of the pupils, thus giving greater meaning and usefulness to the work of the school by securing the sympathy and coöperation of the parents.

In the Academy, a department of the University in which several hundred boys and girls of high school grade are completing their preparation for entering colleges, last year, for the first time, courses in secondary school agriculture were given and this gave an opportunity to put the test to some theories as to what this work ought to be and how it could be best handled in these grades.

The introduction of a course in poultry was not considered until August, 1909, and no provision had been made for appropriating funds to purchase the material needed and maintain it during the year. However, a few hundred dollars were generally squeezed out of funds intended for the running



expenses of the Agricultural Extension Department and this sum enabled us to make a very modest beginning in work with poultry at the University of Illinois.

So much in explanation of why this work has been started and of the necessary limitations under which it has had to support itself and do its work this year.

First, we secured from the Agronomy Department of the Agricultural College the use of a strip of land sixteen rods long and four rods wide, lying just west of the Forestry. Fortunately my own residence was almost adjoining it, making it easy for me to give close supervision and to supply some things that were necessary in carrying on the work which our meagre funds would not allow us to buy this year.

Eight yards measuring two by four rods were fenced off and in each yard a portable house eight feet square was built. As we had no place for storing feed it was necessary to use one of these houses for that purpose, so only seven houses were available for housing poultry.

I wanted to stock these yards with first-class birds of several of the most popular and important breeds of chickens, but my funds would not allow me to offer prices that very high grade stock commands in the market. Two dollars a bird was my limit and that is what I paid for every chicken I bought.

However, I went to prominent breeders of pure-bred fowls and presented the case to them, asking them to be as generous and public-spirited as they could and saying that I believed it would be to their interests also to have representative birds of their breeding in the University poultry yards. Several of them saw it in that light and sent birds that would have sold undoubtedly to private purchasers for a higher price than I was able to offer for them, but in most of the yards the fowls are not of as high grade as we ought to keep for such purposes as we use them for and especially when they are in so conspicuous a place.

I hope it may be possible to secure for our pens next year breeding stock of better quality and more representative types.

The breeds used for the work this year are Barred Plymouth Rocks, White Wyandotts, Rhode Island Reds, Light Brahmas and White Leghorns. This selection gave us the three most important types of chickens, viz., the American or General Purpose, the Meat type and the Egg type.

The houses, though small in order to be portable as is desirable for high school use generally, were well built, modern and up-to-date in construction. They are of the style used by the poultry department at Cornell University for their colony houses and have proved very satisfactory this winter. They are all open-front houses and have demonstrated to those who have been watching the working of our little poultry plant that this feature of housing fowls is successful.

We have fed only dry feeds. A mixture of wheat, cracked corn and sprouted oats in about equal quantities is thrown into the litter morning and afternoon. Each hen receives a small handful at each feeding, about two ounces, and in addition a hopper hanging on the wall in each house is kept supplied with a dry mash of wheat bran, middlings, corn and oats, chop and beef scraps. The first three materials are mixed in equal quantities and about 10 per cent of the mixture is dried beef scrap put up by the packing houses.

Many people have shown much interest in the system of feeding because the results in the production of eggs have been good during every month from the beginning in October. Some of the hens have given better results than the others under the same treatment. Thus far the Rhode Island Reds and the Plymouth Rocks, both being pens of year-old hens, have shown finest results, and the White Leghorn pullets have kept in the rear. This does not necessarily show a superiority of one breed over the other, but is probably due to the fact that we were more fortunate in getting better laying strains from some breeds than for others. It is due to the Rhode Island Reds to say that they have won the admiration of every student and visitor who



has been watching their work not only by their uniformly good egg record, but also by the perfectness of the eggs and the appearance of vigor and hardiness of every individual in the flock.

Because of the wide-spread interest in the claims made by the Philo System of keeping poultry and raising little chickens my students have been busy on Saturdays and holidays building Philo colony coops and brooder coops in order to test the merits of its new method of poultry culture by the side of the older-fashioned ways of doing the work. Our material is necessarily cheap and crude, the tools are few and simple and the workmanship rather unfinished in most cases, but there is an abundance of enthusiasm and faith in the importance of the work, and these are the factors of real value. The work is done in my furnace cellar where it is warm and we have electric lights.

The Reliable Incubator Company of Quincy, Ill., has generously presented us with a 200-egg-size incubator and a brooder for our use, and M. M. Johnson of Clay Center, Neb., has also sent us an Old Trusty incubator that has a capacity of 100 eggs. In addition the Prairie State Incubator Company make us an offer of a reduction of 50 per cent on their incubators and brooders which we shall probably avail ourselves of in order that we may have a fairly complete little equipment for our work in poultry in the Academy. The incubators will be installed in a room in my basement which will be fairly convenient for class purposes.

The sale of fresh eggs to University people and other neighbors at the highest market price (forty cents a dozen now) is bringing in a nice sum each month which pays for the feed and assistance and is making people appreciate the value of the poultry industry.

The work of raising and hatching little chicks will soon begin and the class will be busier than ever.

Nearly every poultry journal comes to our reading table and the pupils are gathering a large amount of poultry literature in bulletin form. Besides the students from the Academy there are a number of special students in agriculture from the Agricultural College who are taking the poultry work in the course.

I have made this a much longer story than I had planned. What I have wanted to do is to show that instruction in poultry is work well adapted to high school conditions, that it need not be difficult or expensive to handle and that it can be made very popular and interesting both with pupils and their parents. I believe every poultryman will see that it is a movement which he can and ought to help promote.

#### LARGE PROFIT IN POULTRY BUSINESS.

(Miss Kate Maxcy).

MR. CHAIRMAN, LADIES AND GENTLEMEN: I was a little afraid that there wouldn't be anything left for me to say but, will say some of the important things over again to make them more emphatic.

This is a topic in which I am greatly interested, although it is one that is not given the attention that it rightfully demands. It is a branch of work, however, when properly handled, I may say when it is intelligently handled, that will yield, from a view point of dollars and cents, larger returns than some other branches the farmer takes up and pays more attention to; in other words, I claim that the same amount of attention and intelligent effort expended in the poultry business will yield larger returns than many of those within my hearing have any conception of.

The value of the production each year runs away up in the millions.

There are many of the states that give short courses lasting from two to twelve weeks, and anyone that has the time to attend will find much to be learned there to their advantage. Also, there are complete courses. The instructors in these poultry departments do a good deal of circular work, sending out literature throughout the State. I don't know whether Prof. Rice touched on that or not, but the fact is that thousands of pamphlets each month are sent out, each taking up some important branch of this work, and



by filing these pamphlets as they are received from month to month, in a very short time you will have accumulated a very instructive poultry library, touching on almost every feature of the business and giving hints and suggestions that are invaluable to those engaged in that line of endeavor.

I understand that there is a movement on foot to increase the appropriation for this literature work, and heard the other day that Governor Deneen was much in favor of this and that it had his support, which is very encouraging to us.

One of the questions which has been the subject of many very eloquent addresses is "How to raise more and better poultry." That is a very broad subject and time prevents my going into it in detail. Much has been done in this country looking toward the raising of more poultry with the present facilities, and experimental work is being pushed forward every day how to raise better poultry. Canada has done valuable work in this line.

In Michigan it has been and is the aim to make all the courses just as practical as possible and get right down to the more important every day practices and apply them in such a way as to get the very best results in the most economical way before those in this line of endeavor.

Other states are taking a step forward in this industry. Ohio has a bill asking for \$10,000 to be appropriated for experimental work, and as Prof. Rice told you, we are waiting for the \$20,000 which this State will, I hope, appropriate.

Some of the other states are a little more up-to-date. Pennsylvania, for instance, has a correspondence course in poultry, which consists of nine lessons, and a small fee is charged, barely enough to defray the expense of carrying on the work.

Indiana has just received \$5,000 for this work; Massachusetts has just been enjoying an appropriation for the past fifteen years. Missouri as yet has no course in her university, but I understand that state also is to take a keener interest in poultry matters and I may add that although the university of that state does not go into this subject, yet the Missouri State Fair held this last year was said to be the best of any show held. Colorado has \$5,000 to support a department of poultry husbandry. They are doing very good work in Kansas. The data which we collected from that state is valuable. I am sorry to say that Rhode Island has not done very valuable work, but California, Idaho and Oregon have made great advances in the poultry affairs of their respective states.

The State of Illinois produced about \$40,000,000 worth of poultry in the last year and it does seem that an appropriation commensurate with the output should be allowed by the State Legislature for such work as we find it necessary to carry on. At our last State show there were nearly 5,000 people in attendance. It shows the great interest being taken in this work. There is a plan on foot for a State Board, to consist of one representative from each section, to handle the vast amount of business done.

In reply to the question "What ought to be done?" there is very little that can be done without the requisite money and the legislature ought to appropriate a sufficient sum to create a department of poultry husbandry. There should be a sufficient appropriation to encourage much more experimental work. A great many of the results reached are due to the efforts of other states. Will Illinois be able to do as much as some of the other states?

Of course it takes time to produce these results. We want now a department where our people can take up anything in the experimental work which seems necessary to the management of poultry farms, just like experimental work is done in matters of horticulture, bee-keeping and gardening. We want a department in charge of competent instructors to whom we can apply when we are in need of information on any particular point concerning which there is doubt. When our chickens are dying from some unknown cause, we ought to be able to call on some State department that has studied the various diseases pertaining to chickens, so that we can shut off this loss. Also, we want to know about the best and cheapest foods for poultry; we want to know the best way to handle poultry as a time saver, a saving of money and labor.



Poultry is one of the branches of agriculture and we should know more about it, and now let me impress upon you the thought that we should all of us earnestly strive to have an appropriation made by the State consistent with the magnitude of this branch of our work. We need an appropriation and we should take it up individually or through a committee which should be appointed to interest the law makers of the State in seeing that we get it.

Let us adopt the advertising plan and send letters to every legislator who doesn't know as much about poultry associations and poultry work as he ought to. Let us take a stand in this matter for the good of the department of the State University and let us be in doubt no longer. The appropriation will surely be effective of the best results.

The Chairman—I believe that this matter could be well treated in an educational way in Illinois and the appropriation that is sought will surely come. Do you realize what that great show in Springfield means, its far-reaching effect? What is the amount annually appropriated for that?

Prof. Heimlich—About \$2,000 a year for the State show.

The Chairman—There is a wonderful amount of money spent in the State of Illinois every year on this department and it is well spent.

There are bulletins issued from the State and also there are bulletins issued by the agricultural department at Washington and a postal card saying "Please send me all Farmers' bulletins relating to poultry raising" will bring you many instructive and valuable hints, suggestions, new methods of handling, proper care of poultry, comparisons of the experimental work done and in fact information of untold value to poultry raisers. Then if you write to the different universities you will get the benefit of the work done in the different states. Miss Maxcy has given you a few suggestions as to what some of the states are doing and in addition to those named by her I might suggest that Kentucky and Maryland have done much in this line. There is any amount of this information which is free for the asking. It is simply a matter of obtaining bulletins which are at your disposal.

Prof. Heimlich—I was spoken to by the chairman to say something of the present day of the State Poultry Association. You are all familiar with the present plans of the present association and if we successfully carry one-half our present hopes we will have succeeded beyond all the other states that I know anything about.

There is, among other of our plans, a movement to get a representative from every county, every district, and the privilege we accord each exhibitor, whether successful or not of finding out why his fowls didn't win or why they are more defective than others, so they may take advantage of that during the year ensuing so that by the next State exhibit they will have learned something and it will be an educational advantage to have everybody work in closer harmony. Education is what we must have. Our exhibits must be educational. Distribute throughout the country valuable information, let the people know what we have found by hard work, by the expenditure of money; on the other hand, we can learn from others what they have done. Much has been said about the appropriation. We should interest the law makers so as to get our appropriation. Education is what we want and I shall devote this summer to teaching right along the lines most practical, and I believe I can succeed, in a measure at least, in furthering the educational work in these matters.

Miss Maxcy—There was one thing I was going to speak about. They are planning this year to hold another show. Last year 200 members were there. I am referring now to the shows in smaller districts. Our own county is organizing and other counties are organizing. Make it county-wide and we will have it State wide.

Chairman—I will just add this word on what may be done in school. I had a letter from a little boy of 13 years of age: "A teacher of my school said that if I wrote to you for information you would write to me. Father has built me a \$300 concrete house for poultry and has helped me in buying three different breeds of fowls. I drive three and one-half miles to school and I do my poultry work during the morning hours. It will be because of the



help and encouragement that mother gives to me I am going to succeed in it. If you know of anything that will help me I should very much appreciate your sending it to me."

I want to thank every one of you for your kindness and patience during this meeting and hope you may greatly benefit from it. We all thank you very much. (Applause.)



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# Illinois Farmers' Institute

CIRCULAR No. 4



## Important Insects of the Truck Gardens of Illinois

General farm methods for control of insects—

Life History—Prevention—Remedies—

Formulas—Miscellaneous directions

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By

J. J. DAVIS,

Assistant Entomologist for Northern Illinois

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(Reprint from Vol. 16, Illinois Farmers' Institute Report, 1911.)

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# PRELIMINARY REPORT OF THE MORE IMPORTANT INSECTS OF THE TRUCK GARDENS OF ILLINOIS.

(By J. J. Davis, Assistant Entomologist for Northern Illinois.)

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*Introductory Note*—The following paper on the more important insects of the truck-farm and vegetable garden was prepared by Mr. John J. Davis while he was in the service of the State Entomologist's office as assistant for northern Illinois. It was planned as an article for the Entomologist's report, but is published in the report of the State Farmers' Institute as a means of giving it earlier and wider circulation among those most immediately interested in its contents. Besides the main results of Mr. Davis' work on this subject for three and a half years, while stationed at Chicago, it contains an abstract of the contents of published papers on its topic.

STEPHEN A. FORBES, *State Entomologist.*

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Vegetable gardening is now one of the most important of the various agricultural interests of Illinois. According to the census of 1900 there were 256,213 acres in vegetables in Illinois in 1899, and the value of the products amounted to \$10,346,797.00, this being the fourth largest valuation of such products for all the states. The average valuation of vegetables was \$42.00 per acre, while that of all crops taken together was but \$10.04. Although the gardening industry in Illinois, and especially in Cook county and counties adjoining, has greatly increased since 1899, the figures for that year serve to indicate the relatively great importance of vegetable-growing in Illinois.

Chicago is the principal center of the truck-garden industry of this State, and for a distance of 12 to 18 miles north, south and west of the city, agriculture is almost wholly gardening. This area is especially well adapted to such farming, as the more or less sandy character of the soil permits early tillage—a very important fact from the truck gardener's point of view, since it enables him to get his products on the market at an early date, while prices are still high. Cook county growers have a market close at hand so that they can personally dispose of their produce, making sales from their own wagons, thus avoiding freight and commission charges. Further, Chicago affords an ample supply of manure for continuous fertilization, which is absolutely necessary where such intensive farming is practiced, and where so much is taken from the soil each year.

Another important consideration is the labor supply; for such crops as onions and cucumbers require large numbers of laborers at certain times of the year, and in isolated localities and in small towns there is usually insufficient help in the busiest parts of the season. In Cook county, however, the city of Chicago can usually furnish all the labor required, and at a cheaper rate than in remote localities.



Probably the most important garden product of Illinois is the potato. The area in this crop in Illinois in 1899 was 139,464 acres, and the estimated value of the product was \$4,702,033.00. In Cook county alone there were 15,336 acres in potatoes. Onions and cabbage are important crops, as are also asparagus, celery, beets, and that class of vegetables known as general truck, which includes radishes, lettuce, parsnips, carrots, rhubarb, beans, etc. The growing of sweet corn, tomatoes, beans and peas for canning, and of cucumbers for pickling, is becoming a prominent industry, and the same is true of melon-growing in many parts of the State. Cucumbers, tomatoes, lettuce and radishes are extensively grown in hothouses, as well as out-of-doors.

The gardening regions are more or less divided into areas in each of which a certain class of products is cultivated. For example, a strip of ground half a mile or a mile in width may be used for onion culture almost exclusively, or it may be in potatoes or cabbage, or both, or it may be devoted to general gardening.

The more intensive the culture of a crop, the more important becomes the control of its insect enemies. Land is especially desirable for vegetable gardens near the market centers, and as these are almost invariably large cities, such land has a high value, and the greatest possible returns must be realized from it. To insure this the control of injurious insects becomes of great, if not prime, importance.

#### *General Farm Methods for Control of Insects.*

*Clean Culture*—Probably the most valuable of all farm practices for the control of insects is clean culture, by which is meant the clearing away of all useless vegetation, and the numerous other general measures which leave for insects no sufficient winter shelter, or adequate protection from the weather, the birds, and other natural checks upon their numbers. In fall, rubbish of every kind, and especially standing unmarketable cabbages and onions, should be collected and destroyed, to deprive insects of their breeding and hiding places. These methods are particularly helpful in destroying cabbage and onion maggots, cutworms, thrips, plant-lice, potato-beetles, and striped cucumber-beetles. In the summer likewise, and especially early in spring, it is important to keep down the weeds, for they promote a rapid multiplication of insects, and provide temporary breeding places for some species pending the appearance of their special garden food-plants. An early cutting of weeds is further beneficial by preventing their seeding.

*Importance of Healthy and Vigorous Plants*—It is a common observation that healthy and vigorous plants withstand the attacks of insects much better than weak and neglected ones. One of the principal requirements for vigorous growth is fertility of the soil. Good seed is necessarily an important item, and, further, it should be properly planted and the crop should be thoroughly cultivated to secure strong and healthy plants. Such plants will also endure the effects of drouth for a much longer time than weaker plants.

*Rotation of Crops*—Crop rotation is one of the most valuable of the cultural methods for preventing insect attack. As a rule, it is bad practice in truck-gardening to grow two successive crops of a vegetable, or of nearly related vegetables, successively, on the same piece of land; and, further, a crop should be planted as far as possible from the location of the same vegetable the year before. Especially is rotation desirable when the crop was badly damaged by insects the previous year. Some of the more important insects whose injuries may be checked or controlled by this method, are cabbage and onion maggots, potato-beetles, wireworms, white-grubs and cutworms.

*Fall Plowing*—Another important means of insect control is fall plowing. In the northern part of Illinois, where the winters are usually severe, the value of this measure seems considerable, for its main object is to bring



the insects in the soil nearer to the surface, where they may be killed by the cold. It is necessary in such localities to plow as late in fall as possible, when the insects are more or less inactive and unable to go very deep into the ground. Disking and harrowing in the fall is often helpful.

*Time of Planting*—It is often possible to avoid insect attack by either early or late spring planting. The object in planting early is to have the crop well started and sufficiently advanced to withstand insect attack when it occurs; while the object of late planting is to bring the crop on after the disappearance of the insect likely to injure it. I have known of but one instance of such benefit derived from early planting, and this was in the case of the onion-maggot. Late spring planting is a successful measure of protection against some insects, such as cutworms, the striped cucumber-beetle, flea-beetles, etc.

*Early Detection of the Presence of Insect Pests*—Usually an insect has already done much damage to a crop before its presence is known, and often it is discovered too late for the successful application of remedies. This makes it necessary for the gardener to keep vigilant watch of his crops in order to know when to spray or otherwise to treat them; that is to say, he should detect the presence of an injurious insect in his garden almost as soon as it appears.

Insect injury may be recognized by the actual detection of the culprit; by the failure of seed to germinate; by injury to the leaves; by a wilting of the plants; by the wilting or curling of the leaves, caused by aphid attack; by an uneven stand; or by the slow growth of the plants.

The more important insects known to be injuring garden products in Illinois will now be discussed under the various crops, taken up in alphabetical order. Methods of preparing the principal insecticides used by the gardener are given at the end of the article.

## ASPARAGUS.

The area in asparagus has greatly increased in Illinois in the last few years, and the plant is now one of the most important products of several gardening districts. Only one insect—the common asparagus-beetle (*Crioceris asparagi* Linn) has been found doing any considerable damage to this crop, and this in only two localities.\* Where present, however, it is an important pest of this plant, and the increasing acreage in asparagus may cause its spread over a much larger territory. The asparagus grower should be on the continual lookout for it, and at its first appearance take immediate measures for its control.

### THE COMMON ASPARAGUS BEETLE.

#### *Crioceris asparagi* Linn.

Both beetles and larvæ of this species cause injury by feeding on the young shoots as they appear above ground, and by defoliating the plants later in the season. In the first case the young shoots are rendered unsalable or of poor quality, while the loss of foliage greatly weakens the plants, especially seedlings.

The beetle (Fig. 2, *a*) is one-sixth to one-fourth of an inch in length, and is gayly colored, the thorax being reddish, and the elytra, or wing-covers, more or less striped with lemon-yellow and dark blue, and having a reddish border. Early in spring, at the time of the first cutting of asparagus, the beetles emerge from their winter quarters and lay their conspicuous, yellowish, slender eggs (Fig. 2, *b*) end to end, in rows of eight or less, on the stalks or leaves of the asparagus plants. In our experiments a single female, in confinement with a male beetle, laid a total of 386 eggs

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\*Since the above was written it has been found in other localities, and it is probably only a matter of a few years until it will become common throughout our asparagus-growing districts.



during her life of 29 days—from May 13 to June 11. In about a week the eggs hatch into “grubs,” or larvæ (Fig. 2, *c*), which immediately begin to feed. These become full grown (Fig. 2, *d*) in about two weeks or less, at which time they are a quarter of an inch in length, or slightly shorter, fleshy, and of an olive color. The mature larvæ go into the earth and change to pupæ (Fig. 2, *e*) just beneath the surface.

They remain in this condition nine to twelve days, and then change to beetles, which, in turn, come out of the ground and lay eggs for a second generation. The beetles of this generation go into hibernation in the fall, about the middle of September in ordinary seasons. It is not certain that there are but two broods a year in Illinois; the life history has not been



Fig. 1—Common Asparagus beetle, *Crioceris asparagi*, larvæ and adults, on asparagus. Natural size.

completely worked out for this State, but observations made in northern Illinois indicate that in ordinary seasons from two to three broods occur there. We have succeeded in raising three broods in one season in confinement, under what were probably optimum conditions, in the latitude of Chicago.

*Methods of Control*—Volunteer asparagus plants should be kept down in early spring, as they afford a good breeding place for the larvæ. Since the shoots are cut for the market every day or two, the eggs which may be deposited on them do not have time to hatch; and if the volunteer growth is kept down there will be little chance of any eggs hatching in the field.



Fresh air-slaked lime, dusted on the plants early in the morning, while the dew is on, has been reported by Dr. F. H. Chittenden as destructive to all grubs with which it comes in contact.

Arsenical poisons are of value upon plants that are not being cut for food, and possess the advantage of destroying beetles, as well as grubs. The

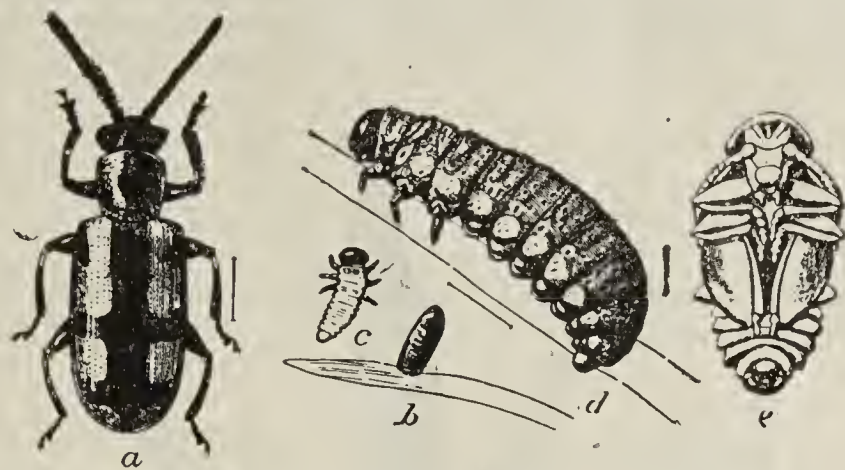


Fig. 2—Common Asparagus Beetle, *Crioceris asparagi*: a, beetle; b, egg; c, newly hatched larva; d, full grown larva; e, pupa. Enlarged as indicated.

application should be made at frequent intervals, or as often as the larvæ reappear. Arsenate of lead or Paris green in water are excellent sprays for this purpose. Dry arsenicals are also effective—as Paris green mixed with lime, with lime and flour, or with land plaster.

#### CABBAGE AND CAULIFLOWER.

In Cook county gardens, cabbage and cauliflower rank in importance with such garden products as onions, cucumbers and potatoes. Not only are they among the most generally grown vegetables, but they are peculiarly susceptible to insect attack. In Illinois I have found the following insects doing noticeable damage to these crops; the imported or green cabbage-worm, cutworms, the root maggot, plant-lice, and flea-beetles.

##### THE IMPORTED CABBAGE-WORM.

*Pontia rapae* Linn. (*Pieris rapae*.)

There is not a gardener who is unfamiliar with this common and destructive caterpillar. There are several "cabbage-worms," but the commonest is the larva of the white butterfly (*Pontia rapae*) always to be found flying around cabbage fields during the summer. It emerges early in spring, having passed the winter in the chrysalis or pupa stage. The greenish eggs, small, slender and ribbed, are soon deposited, usually singly, on the leaves of early cabbages or other cruciferous plants. The velvety green larva (Fig. 3, a) begins to feed ravenously on the leaves immediately upon hatching. It gets its growth in ten to fourteen days and becomes a chrysalis (Fig. 3, b) changing to a white butterfly (Fig. 4 and 5) some eight to twelve days later. The length of the season and other general conditions have much influence in determining the number of generations in any year. There are certainly as many as three, on an average, in northern Illinois.

These caterpillars are not only injurious to cabbage, cauliflower, and other cruciferous plants, but they sometimes do much damage to lettuce.

*Parasites*—There is hardly a field of cabbage or cauliflower infested with these green caterpillars in which we can not find masses of small white or yellowish cocoons. These cocoons are formed by small larvæ which live within the bodies of the cabbage-worms, soon killing their hosts. Minute wasp-like adults emerge from the cocoons, and deposit eggs in the bodies of other cabbage-worms. This parasite (*Apanteles glomeratus*) is a valu-



able friend to the cabbage and cauliflower grower, and it is sometimes abundant enough to free the field of cabbage-worms, at least for the time being. Many gardeners make the serious mistake of destroying the cocoons of this parasite, believing them to be the eggs of the white butterfly.

Another parasite, *Pteromalus puparum*, kills many pupæ, or chrysalides, of this cabbage-worm, and materially decreases the number of the next generation. Often the chrysalides from which the butterfly should have emerged, are dark brownish to black, and when broken open will be found to contain



Fig. 3—Cabbage Butterfly, *Pontia rapae*: a, larva; b, pupa. Natural size.

many maggot-like larvæ or dark brown pupæ. These have developed from eggs deposited in the living chrysalides by adults of *Pteromalus puparum*, which, like the parasite of the larva, is a small wasp-like insect. I have reared 48 to 58 of these parasites from single chrysalides.

In one large gardening district where cabbage and cauliflower are grown extensively, I could not find a single living worm or chrysalis Aug. 26, 1908, although a few weeks before both had been abundant. All had been killed by their parasites.

*Remedial Measures*—The following remedies are equally effective for any of the several caterpillars feeding on cabbage leaves, with the exception of cutworms, which will be treated later.



Fig. 4—Cabbage Butterfly, *Pontia rapae* male, natural size.

The use of arsenicals on cabbage and cauliflower is often discouraged because of the supposed danger to the consumer. Experiments with arsenate of lead and Paris green have been made, both in New York and in Kentucky, in which the sprayed plants were analyzed to determine the amount of poison remaining on them. It was found that only a slight trace, if any, was present—in no case enough to be dangerous, even if all consumed by one person. Cauliflower, however, should not be sprayed after the “flower” has begun to form, nor should cabbages be sprayed after they are two-thirds grown.



Paris green is one of the standard remedies, and is more used today in spraying for cabbage-worms than any other insecticide. It may be applied dry or suspended in water, and specific directions for either use of it are given at the end of this article (page 256). A resin-lime mixture has been highly recommended by Mr. F. A. Sirrine,\* who, after experiments with it, concluded that the yield of cabbages was increased 60 to 100 per cent by the treatment. He figures the cost of it at about \$2.00 an acre. Two applications are usually sufficient. Directions for the preparation of this mixture also may be found on page 256.

Arsenate of lead has been successfully used against the cabbage-worm, but has the disadvantage of not adhering as well as the resin-lime mixture, although better than Paris green alone. It consequently must be applied oftener—sometimes as many as three or four times a year, but ordinarily only twice. It has the advantage of being easy to prepare, and, as it is white, one can easily see when the plants have been thoroughly sprayed.



Fig. 5—Cabbage Butterfly, *Pontia rapae*, female, natural size.

Pyrethrum is also recommended for this insect. It is more expensive than the arsenicals, but has the two advantages over them that it is not injurious to man, and that it can be used later in the season than they,—that is, when the heads are nearly formed.

Hot water at nearly boiling point will, of course, kill the worms, and is said to be harmless to the plants. Lime has been used against these worms, but it is ineffective, especially when they are numerous. Professor J. W. Lloyd says\* “cabbage-worms were abundant late in the season, and in spite of five applications of air-slacked lime did considerable damage to the crop.”

Cabbage stalks and other debris should be removed from the field in fall and burned, unless, as recommended by Dr. F. H. Chittenden,† a few of the plants are left and poisoned as bait for the last generation of the insects.

#### THE VARIEGATED CUTWORM.

*Peridroma margaritosa* Haw. (*Agrotis saucia*, *Peridroma saucia*.)

Cutworms are sometimes very injurious to cabbage, cutting off the young plants and killing them outright. For this reason they are a worse pest than the green caterpillars; but they are not so widespread, and are therefore of less economic importance. The life history of the above species and a description of it are given in connection with insects affecting lettuce (pages 240-242).

*Remedies*—Poisoned bait (see page 260) is probably the best remedy for cutworms. If they are known to be present, the bait should be put on the prepared field just before the cabbage plants are set out. If not, it should be used as soon as the presence of cutworms is recognized.

\*A Spraying Mixture for Cauliflower and Cabbage-worms. Bull. N. Y. Agr. Expr. Station, No. 144 (Sept., 1898) Geneva.

†The Farmers Vegetable Garden. Bull. Ill. Agr. Expr. Station, No. 105, (Feb., 1906), p. 190.

‡Insects Injurious to Vegetables. p. 139. Orange Judd Co., New York, 1907.



Spraying with an arsenical poison, such as Paris green, will destroy some of the insects if the spray is applied to the stems near the ground; but the stalks are probably more frequently cut off just below the surface of the ground than just above it, and in the former case the poison would not be eaten by the cutworms.

The collection of cutworms by hand is advised for some crops, but it would generally be too expensive for large cabbage fields.

#### THE CABBAGE ROOT-MAGGOT.

*Phorbia brassicae* Bouché. (*Pegomyia brassicae*, *Anthomyia brassicae*.)

One of the most destructive enemies of cabbage and cauliflower in Illinois is the cabbage root-maggot. It is white or cream colored, resembling the onion-maggot (Fig. 25), which is known to all Illinois gardeners. It is one of the immature stages of a fly which is much like the housefly, in ap-



Fig. 6—Cabbage seed-bed with frame and screening in position, to keep out the Cabbage Maggot, *Phorbia brassicae*.

pearance, but more cylindrical, somewhat smaller, and of a grayish or brownish color. The winter may be passed in either the adult, puparium, or maggot stage, the flies hibernating in rubbish, buildings, or any accessible place that will afford shelter, the puparia in onion bulbs left in the fields in the soil, and the maggots in the refuse bulbs. Early in spring the flies deposit their small, elliptical white eggs in small cracks and crevices near the stem of the plant, or on the stem beneath the surface. Usually within a week—not so soon if the weather is cool, but often within 24 or 36 hours in the warmer parts of the year—small maggots hatch from the eggs, and immediately go into the ground and begin to feed on the roots or stalk. Becoming full grown in a few weeks, they leave the roots to pupate in the soil near by. They remain in this dormant stage, as oval brown puparia, for about two weeks (in summer), and from these the adult flies emerge. There may be two or more generations in Illinois, according to the length of the season.



Most of the injury to cabbage and cauliflower by this maggot is done while the plants are small, and particularly to early cabbage. For this reason the acreage of early cabbage has greatly decreased in this State within the last few years.

*Economic Control*—Many methods have been recommended by various writers for the control of the cabbage root-maggot, but most of these are preventive rather than remedial. Cabbage seldom brings a high price, and many measures that have been proposed are impracticable because of their cost.

For the *prevention of maggot attack in seed beds*, probably the most successful and practical method of protecting the young plants is that of screening them, as suggested by Dr. James Fletcher,\* and later successfully demonstrated on a large scale by Mr. W. J. Schoene.† This consists in growing the seedlings under cheap frames, made of light wood and covered with cheesecloth (Fig. 6), to protect the plants from the cabbage-maggot flies. In Mr. Schoene's experiments it proved very successful. He says: "Plants raised under cloth grew faster and reached the desired size for transplanting one week before the seedlings in the check [untreated] area. The screen sets were seasoned by the removal of the covering thirteen days before the time of replanting, and showed no more wilting when transplanted than did the check seedlings."

"The screened bed was entirely free of maggots, and produced 50,000 sets, which were replanted. The check bed, of more than three times the size, yielded only 30,000 desirable plants. The cabbage maggots were generally very destructive to unprotected seedlings."

The total cost for material was approximately 40 cents for each 1,000 plants. The screens not only protect the plants from maggots, but also from the flea-beetles, which often do much damage to young cabbage.

For the *destruction of maggots at the time when seedlings are to be transplanted*, roots not too badly infested for use should either be washed off with water before resetting them, in order to remove the maggots, or, as Professor F. L. Washburn suggests,\* they may be dipped in a decoction of white hellebore—one part of the powder to two parts of water. The latter treatment is preferable, for while the water will have no effect on the maggots except to remove some of them, the hellebore may kill them all.

For the *prevention of maggot attack after transplanting*, probably the most successful measure is the use of tarred-paper cards. Those ordinarily used are made of a thin grade of tarred felt-paper, and are about two and a half inches in diameter. They may be of any shape, but, as a matter of economy, are usually hexagonal, with a slit from one side to the center. The card is placed on the plant by separating the two edges of the slit and slipping the card around the plant so that the stem comes in the middle of the card. The card must then be pressed close to the stem and flat on the ground. This being done, the female fly must lay her eggs either on the card—where there is small chance of their hatching—or on the stem—and if the card is close to the stem the young larvæ hatching from them will be unable to reach the roots—or else on the ground beyond the card, in which case the young larvæ, hatching so far from the plant, would probably be unable to reach it.

A carbolic acid and lime mixture (see page 260) has been recommended by others, but in our experience it proved worthless, the coat of lime cracking and leaving places for the deposit of eggs. After 24 hours the carbolic acid loses its value as a repellant. The mixture is applied along the rows with a sprinkling-can or spray-nozzle as the plants are transplanted, and in such manner as to coat the entire surface thinly around the plants.

Tobacco dust placed around the base of the plants has been found to prevent the female from depositing her eggs on or near them.

\*Insects Injurious to Grain and Fodder Crops, Root Crops and Vegetables. Bull. Central Experimental Farms, Ottawa, Canada, No. 52 (June, 1905), p. 35.

†Screenings for the Protection of Cabbage Seed Beds. Bull. N. Y. Agr. Exper. Station, No. 301 (March, 1908), Geneva.

\*The Cabbage Maggot and other Injurious Insects of 1906. Bull. Minn. Agr. Exper. Station, No. 100 (Dec., 1906), p. 12. St. Anthony Park.



When these maggots have once gained a foothold in a cabbage field it is difficult, if not impossible, to exterminate them. The only practical insecticides which have been recommended are the carbolic acid emulsion, a decoction of hellebore, and carbon bisulfid (see pages 259 and 262), and these have given quite variable results. The carbon bisulfid has been used with success, but the expense of application prohibits its use in large commercial gardens. Hellebore decoction has given us very good results. A third of a pint should be poured at the base of each plant when transplanted, and each week thereafter for three or four weeks.

In using these insecticides it is necessary to make thorough application at the base of the plant before the maggots have had a chance to enter the root and protect themselves.

The application of commercial fertilizers is of much value. They stimulate the plant and make it more resistant to maggot attacks.

Clean farming and fall plowing aid in preventing maggot attack.

The use of "blood and bone," with hellebore, was suggested to us by a gardener, who reported that some of his cabbages had been protected from this maggot by this means, while plants not so treated were seriously damaged by it, as in previous years. We tried this material this year (1910), placing a small quantity of the dry mixture about each cabbage plant after transplanting to the field, but unfortunately for the test, the maggots were not present in injurious numbers either in the treated or untreated plots, and therefore no definite conclusions were reached. Upon examining the "blood and bone" around the plants, however, we found in it many maggots which were bred to adults and determined as *Phorbia fusciceps* Zett, a species closely related to the cabbage and onion maggots, and often injurious to the same crops. The same species infested "blood and bone" when applied to onions, the mixture being in this case drilled in on each side of the row. Although no recommendations can be made from these tests, it is thought best to make brief record of them.

#### THE CABBAGE PLANT-LOUSE.

##### *Aphis brassicae* Linn.

During midsummer or early fall this plant-louse becomes noticeably abundant on cabbage and cauliflower plants, usually infesting the under sides of the leaves in large, packed colonies, which rapidly increase in size unless checked by enemies or unfavorable weather. Both wingless and winged individuals are to be found, and though there are few of the latter as compared with the multitudes of the former, these few winged lice are the chief means of starting colonies in uninfested fields. Like other plant lice, the cabbage-louse gives birth during the summer months to living young, without previous fertilization of the female by the male. In the fall, as observed by Fletcher, Garman, Quaintance, and others, both sexes are produced, and eggs are deposited on the stems and leaves of cabbages remaining in the field. Sometimes, however, viviparous females are found as late as mid-winter, within the cabbage heads.

The lice are about the size of a pin-head, soft-bodied, pale greenish, but completely covered with a whitish powder or bloom which is not unlike the bloom on cabbage leaves.

Plant-lice injure cabbage by sucking the juices of the plant. When abundant, they so disfigure and stunt it, especially the smaller and weaker plants, that it becomes unfit for market.

*Natural Checks*—If it were not for the natural checks on its increase, the cabbage plant-louse would be one of the very worst pests with which the cabbage grower has to deal; but wet weather and its insect enemies greatly restrict its multiplication. It is not only subject to attack by many minute parasites, but it is preyed upon by several kinds of "ladybird" beetles and by the larva of a lacewing fly (*Chrysopa*), whose combined attacks greatly lessen the numbers of the aphids, and hold them in check.



*Remedies*—Probably the most successful method of dealing with the cabbage-louse is fumigation with carbon bisulfid. This substance was tested by us in the fall of 1908 on cabbages badly infested with plant-lice. Fumigation of cabbage or cauliflower on a commercial scale with individual covers for the plants would be too expensive for profit; but an economical method is to cover a considerable area of plants with large canvass or muslin sheets, with props at the corners and center, and wherever else may be necessary.\* The cover being ready, dishes are placed beneath it containing the carbon bisulfid at the rate of a teaspoonful to each cubic foot of space. The edges of the cloth, which should lie on the ground, are covered with earth to prevent, as far as possible, the escape of the fumes. After forty-five minutes to an hour the cover may be removed. This treatment also killed the thrips and cabbage-worms which infested the plants, but it did not kill the parasites concealed in the aphid skins—which fact is greatly in its favor. With exposures of 20 and 30 minutes, nearly all the lice were killed; but



Fig. 7—Cabbage Plant-Louse, *Aphis brassicae*, on head of cabbage.

with only 15 minutes or less, practically none were killed. (For other particulars concerning the use of carbon bisulfid see page 262.) Mr. C. E. Sanborn† has recommended the use of “Aphis Punk” or “Nico-Fume” paper in fumigating plants under cover.

Kerosene emulsion of a 10 per cent strength is the standard spray for the cabbage plant-louse. Care should be taken to spray thoroughly the under side of the leaves, where the lice are usually most abundant, for the liquid must come in contact with the insects in order to kill them. (For formula, etc., see page 258).

Tobacco decoction and various soap mixtures have been recommended for this plant-louse, but they are less effective than the kerosene emulsion. It is hardly necessary to say that treatment should begin at the first appearance of the lice.

\*The Melon-louse and other Aphids, by C. E. Sanborn. Bull. Texas Agr. Exper. Station, No. 89, (not dated) page 47. College station.

†Loc. cit.



Clean culture, especially the destruction of the cabbage and cauliflower stalks in fall, is very important, to destroy the eggs which are deposited on the cabbage and related plants, and likewise to destroy the young and adult lice which may be hibernating on the same kinds of plants.

### THE CABBAGE FLEA-BEETLE.

#### *Phyllotreta vittata* Fabr.

This flea-beetle, often very abundant and destructive, is the only one of the many flea-beetles—so named because of their remarkable leaping ability—which has been found injuring cabbage in northern Illinois. It is a black, shining, oval beetle (Fig. 8, *a*) about .08 inch long, with a broad, wavy longitudinal marking of pale yellow on each wing-cover. It sometimes injures other crops, especially radishes, and its food plants include many weeds. It injures plants by eating innumerable holes and pits in the leaves. It is most destructive to cabbages early in the year, when the plants are less than two inches high, at which stage they easily succumb to such attacks.

I quote in full the concise paragraph on the life history of the immature stages of this flea-beetle given by Professor H. Garman.\*

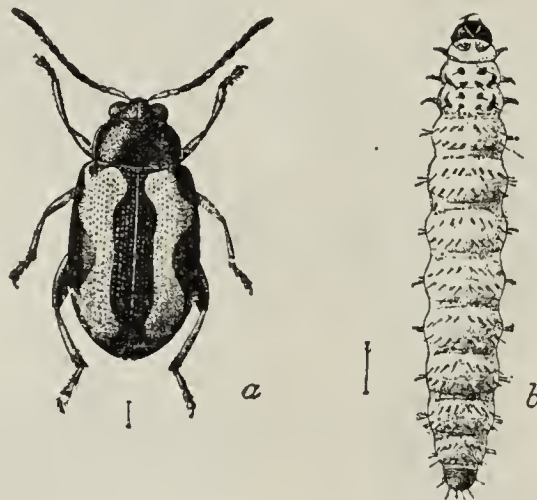


Fig. 8—Cabbage Flea-beetle, *Phyllotreta vittata*: *a*, beetle; *b*, larva. Enlarged as indicated.

"The early history of the cabbage flea-beetle was made out in 1865 by Dr. Shimer, of Mt. Carroll, Illinois. He found that the larva [Fig. 8, *b*] feeds on the roots of cabbage, in which respect it is different from a very similar European beetle, and also from the next one [*P. sinuata*] treated in this paper, both of them being leaf-miners. The eggs of this beetle are placed at the base of the plant. The grubs hatching from them work their way into the earth, mining and feeding on the roots, in some cases completely destroying the plants. When fully grown they are about one-fifth inch long, yellowish white in general color, the head dark brown. They desert the roots when ready to change to pupæ, and pushing into the earth a short distance, make a small cell, in which the change takes place."

*Prevention and Remedies*—A useful method of preventing flea-beetle attack recommended by Mr. W. J. Schoene,† consists in screening the seed beds, as described on page 223 for the protection of seedlings against the attacks of the cabbage root-maggot. The most effective treatment is spraying with Paris green or arsenate of lead, using Bordeaux mixture as a diluent (see pages 256 and 257). To use Bordeaux is not absolutely necessary, but as it is a powerful repellent it adds to the value of the spray.

\*Insects Injurious to Cabbage. Bull. Ky. Agr. Exper. Station, No. 114 (June, 1904), p. 37. Lexington.

†Bull. New York Agr. Exper. Station, No. 301 (March, 1908), p. 170. Geneva.



Many other remedial measures have been recommended, such as powdering the plants with air-slaked lime, soot, road dust, wood ashes, tobacco dust, etc., these substances acting as repellents, or with Paris green and lime—though the latter mixture is more effective as a liquid spray; and spraying kerosene emulsion around the base of the plants is said to destroy the eggs and young larvæ of this insect.

*Cultural Methods*—As this flea-beetle feeds on many weeds, especially the crucifers, all weeds in the immediate vicinity of the garden should be destroyed.

### CUCUMBER AND MELON.

Cucumbers and melons are among the most important garden products in Illinois. In 1899, 2,580 acres were devoted to cucumbers, and 466,876 bushels were marketed. This report does not include cucumbers grown throughout the State under many hundred thousands of square feet of glass. The same year there were 10,963 acres in watermelons and muskmelons in Illinois. The acreage in both these crops has greatly increased since 1899.

The most important insect enemies of these plants are, outdoors, the striped cucumber-beetle, the squash-bug, and the melon aphid; and, in greenhouses, thrips and the white-fly. Although they are not insects, two other greenhouse pests should be mentioned, namely, the red spider, and a nematode worm commonly known as the eel-worm.

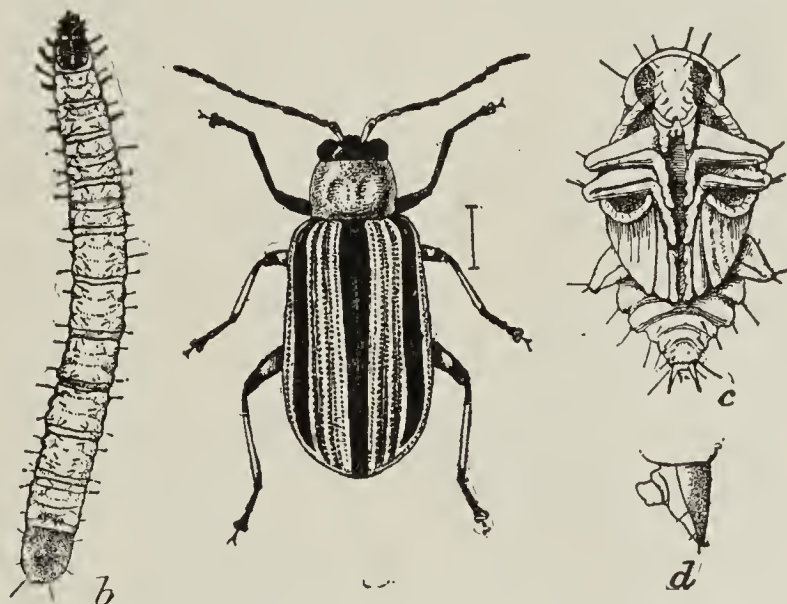


Fig. 9—Striped Cucumber Beetle, *Diabrotica vittata*: a, beetle; b, larva; c, pupa; d, tip of larva, side view. Enlarged as indicated.

### THE STRIPED CUCUMBER-BEETLE.

#### *Diabrotica vittata* Fabr.

Ordinarily this is a pest which the gardener must carefully guard against. As the young cucumber, melon, or other cucurbitaceous plants make their appearance above ground, they are attacked by these ravenous beetles, and large areas may be killed by them in a few days.

The beetle (Fig. 9, a) is small (about two-fifths of an inch long), with black head, yellowish thorax, and yellowish wing-covers, marked lengthwise with three black stripes. It passes the winter in the ground or beneath boards or similar shelter, and as the young food plants appear above ground—usually about the first week in June—it comes forth and feeds on their leaves. If the beetles are at all abundant they may soon devour the small tender plants. They feed continuously and voraciously for a week or ten days, and then commence to pair. The eggs (Fig. 10) are deposited singly, and may usually be found on the under surface of the leaf, on the stem near its base, or on the ground near the plant. The larvæ (Fig. 9, b, d) upon hatching, feed within the stalks or on the roots, or sometimes on the



fruit and vines as they lie upon the ground. The length of the larval period no doubt varies greatly, depending on the food supply and climatic conditions. The pupa (Fig. 9, c) is formed in an earthen cell in the soil, and the transformation to the adult beetle is completed within 7 to 14 days. Although the beetles of this new generation begin to emerge the latter



Fig. 10—Striped Cucumber Beetle, *Diabrotica vittata*, egg, much enlarged, with portion of surface more highly magnified at right.

part of July, they may continue to appear throughout August. Professor Garman, in his studies of this insect,\* found that in confinement the entire life cycle of an individual was 26 to 33 days. It is possible that a second generation may appear in the southern part of the State, but in northern Illinois probably but one full generation occurs under normal conditions.

*Preventive and Remedial Measures*—A large number and variety of methods for the control of this insect have been recommended, but only those which have given promising results will be discussed. One of the oldest methods for protecting the young plants from the cucumber-beetle is covering them with a screen; but while this is very satisfactory in small gardens, it is not so practicable on a large scale as the use of the Bordeaux mixture in connection with a trap crop, as discussed farther on. It has been found that for a short time in spring, before the beetles begin to pair, they may be killed with a spray of Paris green or arsenate of lead, but that they will not feed readily upon sprayed foliage after pairing, and arsenicals alone can not be generally recommended for the cucumber-beetle without further tests of their efficiency.

The use of squash as a trap crop (Fig. 11) in combination with a spray of Bordeaux mixture or Bordeaux and arsenate of lead on the cucumber plants and an arsenical poison on the squash, is one of the best means of preventing the attacks of these beetles. Mr. F. A. Sirrine has given a very complete account of this method of treatment based on his own experiments, and the following is taken largely from his paper:†

Squash seed is planted around the margin of the field about four days' previous to planting it with cucumbers, or other crop.§ At the time of cucumber planting there should be a second planting of squash seed on the margins of the field. At the first appearance of the beetles about half the squash vines should be dusted with some easily obtainable arsenite, and soon after the cucumber plants appear above ground they should be sprayed with Bordeaux mixture, using the 4-4-50 formula (for preparation see page 257). At about the same time the cucumber plants are sprayed with Bordeaux the squash-vines should again be dusted with an arsenite. Two weeks after the cucumber plants have appeared all the squash plants may be removed, except a few which should be left until the cucumber vines have set fruit, as the beetles will feed on the squash flowers in preference to those of the cucumber. Sirrine recommends spraying the cucumbers with Bordeaux mixture three times; first, as soon as the seed leaves are exposed; second, when the third true leaf appears; and last, just before the plants commence to vine. He says: "The cost of three applications of the Bordeaux mixture will not exceed \$2.00 per acre; whereas, the cost of wire covers would be \$40.00 per acre, and they probably will not last over three years."

\**Enemies of Cucumbers and Related Plants.* Bull. Agr. Exper. Station, No. 91 (March 8, 1901), p. 5. Lexington.

†*Combating the Striped Beetle on Cucumbers.* Bull. N. Y. Agr. Exper. Station, No. 158 (May, 1899), pp. 14-16. Geneva.

§Mr. Sirrine informs us that only the Hubbard or the Boston Marrow squash should be used, these being by far the most attractive to the beetles.





Fig. 11—Cucumber field with squashes along its border to attract the Striped Cucumber Beetle.



Repellents are effective against this beetle, and Bordeaux mixture is one of the best, although it is best to use it in connection with a trap crop, as above described. Other much-used repellents are air-slaked lime, land-plaster, sifted ashes, road dust and tobacco dust, but these are not always effective when the beetles are abundant.

Clean culture will prevent much of the damage commonly done by many of the common garden pests, and it is especially effective against the cucumber-beetle. It has been recommended in this connection, that as soon as the crop is harvested the vines be covered with straw and burned. This is a far better practice than that of gathering them up before destroying them, as the latter procedure leaves many of the beetles undisturbed in the field.

### THE SQUASH-BUG.

*Anasa tristis* DeGeer.

The squash-bug, although confining its attacks largely to the squash and other plants of the gourd family, is often very injurious to the cucumber in early spring, when emerging from its winter quarters. It finds its way into the cold frames in which the plants are being started, when no other food plant is available.

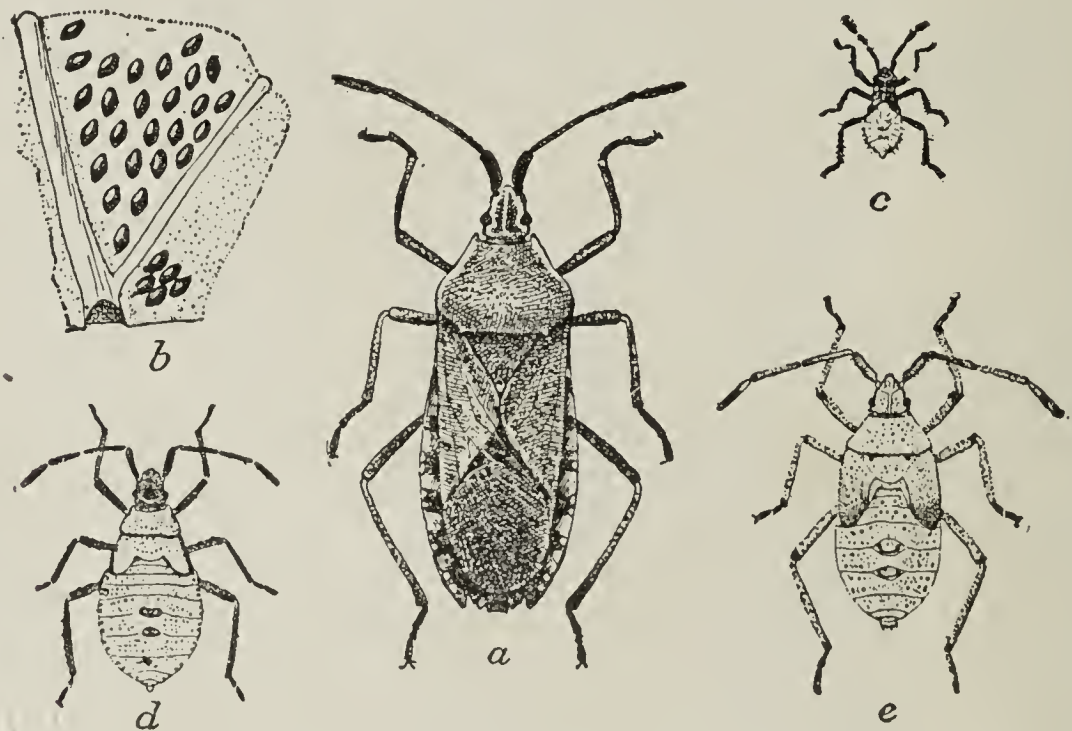


Fig. 12—Squash-bug, *Anasa tristis*: *a*, adult; *b*, egg cluster; *c*, *d*, *e*, young in different stages. Twice natural size.

This large, ill-smelling, dark brown bug (Fig. 12, *a*) hibernates as an adult in rubbish, sheds, and wood-piles, under loose bark on stumps, or in any other available place of protection. In northern Illinois the bugs make their appearance about the middle or the last of June, or even later; but I have found most of their injury to the cucumber done while the young seedlings are in the cold frames. In all such cases these frames were near wood-piles or out-buildings, and during the occasional warm days of spring, when the frames were opened, the bugs gained entrance, the temperature of these beds making them fully active. Shortly after coming from their winter quarters they deposit the conspicuous clusters of glossy yellowish-brown eggs (Fig. 12, *b*), usually on the under side of the leaves. The young, light grey bugs (Fig. 12, *c*) hatching from these, immediately begin sucking the juices of the plants. In their later immature stages (Fig. 12, *d*, *e*)—which differ only in size from the young bug as it hatches from the egg—they feed, as do the adults, upon the juices of the plant. The loss of sap,



however, is not the primary cause of the wilting of the plants. This is due principally, if not wholly, to a liquid poison which the bug introduces into the wound which it makes. In some cases it also gives entrance to a bacillus which causes a wilt disease.

*Methods of control*—Collecting the bugs under board traps is probably the most satisfactory of the various methods suggested for the control of this pest. This should be done in early spring, as soon as the bugs appear. The boards are simply laid on the ground as a decoy shelter for them during the night, and here they may be easily captured early in the morning. The eggs should likewise be collected and destroyed as fast as they are laid on the leaves.

Kerosene emulsion kills the young bugs without injuring the plants if it is very carefully applied, but it is too dangerous for ordinary use.

Here again clean-farming methods are of much importance. Cold frames should be placed at some distance from wood-piles and out-buildings, and as soon as the crop has been gathered the vines should be covered with straw or other easily inflammable material and burned.

#### THE MELON APHIS.

*Aphis gossypii* Glover. (*Aphis cucumeris*).



Fig. 13—Melon Aphis, *Aphis gossypii*, its work.



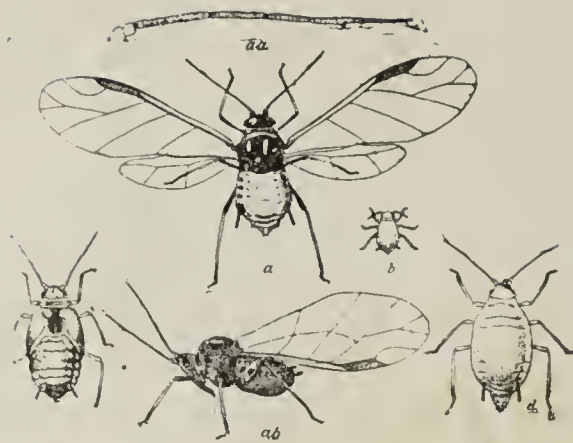


Fig. 14—Melon Aphis, *Aphis gossypii*: *a*, winged female; *aa*, enlarged antenna of same; *ab*, dark female, side view; *b*, young nymph or larva; *c*, last stage of nymph; *d*, wingless female—all greatly enlarged.

Although the truck gardener may not have noticed the melon-aphis on his cucumber plants, a curling of the leaves (Fig. 13) is presumptive evidence of its presence in injurious numbers. It is not only a serious outdoor pest, but is often very injurious to cucumbers in greenhouses.

This plant-louse (Fig 14) varies in color from pale yellowish to blackish green. Its life history and insect enemies are very similar to those of many other plant-lice, such as the one which has already been discussed as a cabbage insect (page 225). Briefly, the melon aphid appears on cucumber and melon plants early in the season, and increases rapidly in numbers during the summer unless checked by its insect enemies or by unfavorable weather. It is still doubtful whether it ever produces eggs to carry the species over winter, but it is known that viviparous females—the form found throughout the summer—may hibernate in some parts of Illinois.

*Remedial measures*—The measures recommended for the control of the cabbage-louse (p. 226) may be used against the melon aphid, and of these, fumigation with carbon bisulfid is doubtless the most efficient (see page 262).

Owing to the large number of its food plants, clean culture is especially important in dealing with the melon aphid, particularly the cutting and burning of weeds and old vines; and fall plowing is also advisable.

In greenhouses, fumigation with hydrocyanic gas is doubtless the best treatment for this insect. The procedure is described on pages 261-262.

#### THE GREENHOUSE WHITE-FLY.

*Aleyrodes vaporariorum* Westwood.



Fig. 15—White Fly, *Aleyrodes vaporariorum*, nymphs on leaf. Twice natural size.



One of the most troublesome and destructive insects with which the greenhouse vegetable-gardener must deal is the white-fly. This little pest attacks cucumbers, tomatoes, peppers, and lettuce under glass, and a considerable variety of flowering and ornamental plants.

The winged adult (Fig. 16) is about .06 (one seventeenth) of an inch in length, and looks as if dusted with flour. The minute irregularly ovoid eggs are deposited on the under surface of the leaves, to which each is attached by a very short, slender stalk. Recently hatched larvæ are flat, oval in outline, and transparent or translucent according to age. They settle on the leaf close to the empty egg-shells, soon attach themselves, and there remain (Fig. 15), molting four times and becoming adult with the last molt. The entire life cycle of the white-fly from the time the egg is deposited until the adult emerges, is completed in a month to five and a half weeks, at the ordinary greenhouse temperature in summer.

The larvæ and pupæ secrete a honeydew which falls on the leaves below them; and on badly infested plants, where this liquid becomes abundant, a sooty fungous growth appears on the leaves covered with it, which hastens the death of the plants.

*Parasites*—In the University greenhouse, at Urbana, many of the plants, especially *Salvia* and pansy-geranium, were badly infested in the midwinter of 1908 by the little white-fly, but two months later these insects were found to have been almost exterminated by a minute hymenopterous parasite, which proved to be a new species, and has since been described by Mr. A. A. Girault as *Encarsia versicolor*.\* It attacks the immature forms of the white-fly, and the infested young may be recognized by their black color, those not infested being pale greenish.

*Remedies*—Fumigation with hydrocyanic acid gas is by far the most efficient means known for controlling the white-fly in greenhouses. In ordinary greenhouses it may be used at a strength of one ounce of cyanide of



Fig. 16—White Fly, *Aleyrodes vaporariorum*, adults on leaf. Twice natural size.

potassium to 3,000 cubic feet of space. In new tightly built houses a smaller quantity may be used; but in very loosely built or weather-shrunken houses more must be used. The mode of using this gas is described on pages 261-2. It is commonly necessary to fumigate three or four times, at intervals of about two weeks.

Fumigation with tobacco stems, or with any of the commercial tobacco extracts, is partially effective against this insect, and where the use of

\**Encarsia versicolor* species novum, a Eulophid Parasite of the Greenhouse White-fly, *Aleyrodes vaporariorum* Westwood. *Psyche*, Vol. XV, No. 3 (June, 1908), pp. 53-57. Cambridge, Mass.



hydrocyanic acid gas is impracticable this treatment is recommended (pages 260 and 263). More fumigations will be required, but is persistently followed up, the white-fly can be kept in check by this means.

#### THE ONION THRIPS.

##### *Thrips tabaci* Lind.

This insect, which is very injurious to cucumber plants in the greenhouse, is discussed in connection with its injury to the onion (page 246). In the greenhouse its life history is the same as out-of-doors, excepting that the life cycle varies greatly in length under the various artificial conditions which prevail in greenhouses. As a rule, cucumbers are started under glass in fall, and it is at this time that the thrips migrates from outdoor vegetation into the houses. It breeds successfully on almost any kind of greenhouse vegetation, and may soon become well established; but it is not usually until midwinter that it becomes abundant enough to alarm the gardener.

*Remedial Measures*—Clean culture is one of the most important means of holding this pest in check. As a rule the grasses and weeds around greenhouses are badly infested with thrips in summer, when the greenhouses are not in use, and on these plants it continues to breed until fall, when the seed heads of such plants as pigweed (*Amarantus retroflexus*), wild sunflower (*Helianthus retroflexus*), and foxtail grass (*Chaetochloa viridis*) are filled with winged thrips ready to migrate into the houses. It is very important, consequently, that all weeds should at least be kept down by cutting, though it is much better to cultivate the land several times during the summer to prevent weeds and grasses from coming up. Cold frames to be used in starting young plants should not be placed near an infested onion field, nor where vegetation is allowed to grow wild.

Spraying and fumigation with tobacco extracts (pages 260 and 263) throughout the fall and winter will hold the thrips in check. The gardener should not wait until his plants are visibly injured, but should continually look for the insect, and as soon as the first thrips is found, should begin operations.

Hydrocyanic acid gas has been used by some with apparent success. In a small greenhouse containing 4,500 cubic feet of space, we were successful in killing 99 per cent of the thrips, without injury to the cucumber plants, by using the gas at a strength of one ounce of cyanide of potassium to 2,000 cubic feet. The maximum and minimum temperatures throughout the period of fumigation, which lasted all night, were 74° and 65° F. respectively.

Kerosene and soap emulsions (pages 258-9) are effective against the thrips before the plants have made much foliage, but at a later period it is impossible to spray thoroughly under the surface of all the leaves, and as these emulsions kill by contact it is of the greatest importance to reach all the insects.

Dipping the leaves of small plants in a soap solution just before transplanting them to the greenhouses has been found useful when plants become infested in cold frames.

#### THE RED SPIDER.

##### *Tetranychus bimaculatus* Harvey. (*Tetranychus telarius*).

This common pest is a tiny mite rather than a true spider. It has been a source of trouble to the indoor cucumber grower for years, and although it can usually be kept in check by careful and thorough cultural and spraying methods, it is a veritable pest when it once obtains a foothold. It is a general feeder, and among the outdoor vegetables which it often injures are celery and eggplant.

This mite (Fig. 17 and 18) is so familiar to growers that a brief description will suffice. It is about one fiftieth of an inch long, oval, with four pairs of legs, and usually a dark spot on each side. This latter character,



however, is not constant. The general color also varies, some mites having a decidedly reddish tint, while others are almost colorless. They spin fine webs over the surface of the leaf—usually on the under side—beneath which they live, and it is largely for this reason that they are hard to reach. The minute eggs are globular, pale and transparent when deposited, but later change to reddish. They are commonly placed on the under surface of the leaf, but sometimes on other parts of the plant. The young mites mature in about ten or twelve days.

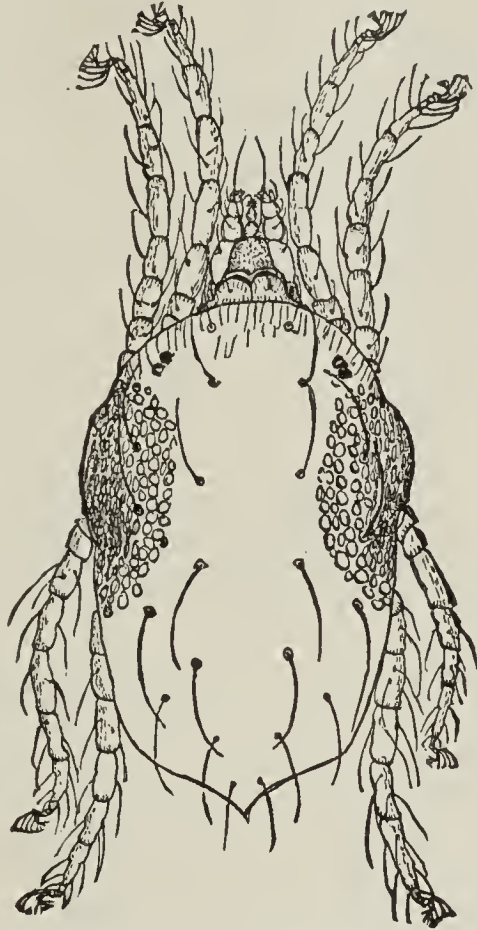


Fig. 17—Red Spider, *Tetranychus bimaculatus*, male, greatly magnified.



Fig. 18—Red Spider, *Tetranychus bimaculatus*, female, greatly magnified.



*Remedial Measures*—This pest can usually be held in check, or even exterminated, by thorough and timely spraying of the plants with water, if the spray is fine and the pressure considerable; but this is a preventive rather than a remedial measure, for, owing to the excessive rate of multiplication of the mites in a hot, dry atmosphere, and owing further to the fact that the web beneath which they live becomes denser as their numbers increase, the spraying is ineffective unless it is done while the infestation is still slight. Indeed, no treatment is of much practical value if the mites have become well established on living plants. A special nozzle introduced by Dr. B. T. Galloway, of the U. S. Department of Agriculture for use against the red spider is very effective, "As it readily serves to keep the leaves in a thoroughly healthy condition, and at the same time wets the beds but little."\*

Fumes of sulphur or hydrocyanic acid gas will kill the red spider, but the strength required is by far greater than the plants will stand. After the cucumber or other crop has been gathered, and before infested vines have been removed, it is advisable to fumigate them with one of these two substances, using one ounce of cyanide of potassium to one hundred cubic feet of space, or burning one pound of sulphur to one thousand cubic feet. It is hardly necessary to say that these strengths will kill living plant. (For full directions for the use of these materials, see pages 261 and 263.)

Sulphur is one of the best remedies for the red spider, and most of the remedies that have been recommended require sulphur as one of the ingredients. Liberally dusting the plants with sulphur after syringing is effective, or, better, applying a spray consisting of one ounce of sulphur to one gallon of water. A little soap added to this sulphur solution will increase its efficiency.

Soap solutions, either whale oil or a neutral soap such as the "Ivory," are of great value in the eradication of the pest, but the addition of sulphur as mentioned above increases their value.

A lye-sulphur mixture has recently been recommended by Dr. F. H. Chittenden, and is said to be more effective than any of the many other materials tested. Directions for preparing this spray are given on page 260.

Whatever insecticide is used, especially when the infestation is severe, should be applied with as great pressure as practicable, for the greatest trouble in controlling this mite arises from the difficulty in penetrating the web which it spins. The stream should also be directed to the lower surfaces of the leaves, for it is here that the spider is most often found.

#### THE EEL-WORM.

##### *Heterodera radiculicola* Greeff.

The Eel-worm is a common pest in hothouses, particularly injurious to the cucumber, and, unfortunately, it is apparently becoming more widespread each year. In Illinois it is known only as a greenhouse pest, and our observations indicate that here, at least, it is unable to survive the winter in the field.

The only unmistakable indications of the presence of this root-feeding worm are the swellings or enlargements of the roots (Fig. 20) often referred to by the gardener as root-knots.\* These root-knots vary in size and shape, largely according to the number of worms present, to their position on the roots, and to the kind of plant. The presence of eel-worms may be indicated by a sickly appearance of the plant, by the dying of its leaves, and by its final collapse, although nothing but an examination of its roots can certainly incriminate the species. Plants are commonly half grown or bearing fruit before they are noticeably weakened by the eel-worm.

\*The Common Red Spider, by F. H. Chittenden. Circ. U. S. Dept. of Agr., Bur. of Ent., No. 104 (Jan. 26, 1909), p. 8.

\*This deformity should not be confused with the club-root of cabbage and related plants, which is due to bacterial disease.



The young eel-worm (Fig. 19) is very minute and elongate. It is provided with a spearlike organ projecting from the head, and with this it pierces the tender root (Fig. 21), in which it ultimately imbeds itself. The worms continue to grow—in width rather than in length—within the root, the female finally becoming club-shaped, but the male resuming its original slender form. The young, hatching from the eggs laid within the root, make their way into the soil, and thence into new roots.

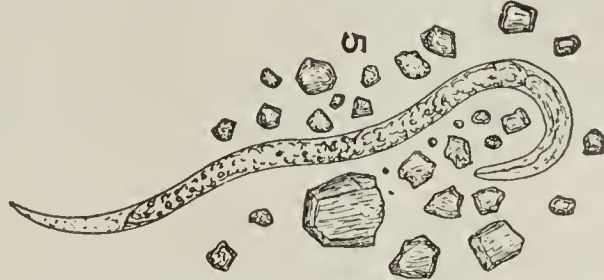


Fig. 19—Nematode Worm, *Heterodera radicum*, among particles of soil. Greatly magnified.

*Preventive and Remedial Measures*—Tools which have been used in soil infested by eel-worms should be thoroughly washed or, better, sterilized before using them in other soil.



Fig. 20—Cucumber roots showing galls of a nematode, *Heterodera radicum*.



Among the most suggestive methods of treating infested greenhouses is that used by Mr. W. F. Preston, of Dixon, Illinois. Having had serious trouble with nematodes on cucumber plants, he used the sterilization process about to be described, but, owing to the "solid bed," worms in the unsterilized soil below soon reinfested the treated soil. To prevent this, a cement floor was put in the bed about ten inches below the top, the wooden sides being retained. The nematodes did not reappear until the following summer, when the vines were old and ready to be removed, as was also the soil. They then gained entrance between the cement floor of the bed and the wooden side-walls. The soil could probably be wholly protected by making the sides as well as the floor of cement, sloping the floor from the center towards each side, and leaving holes along the sides, near the floor of the bed, for drainage.

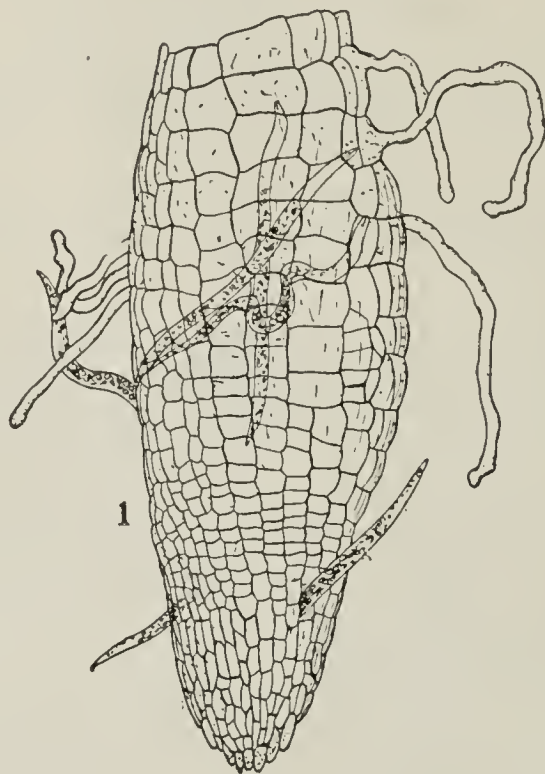


Fig. 21—Tip of cucumber root with young nematodes, *Heterodera radicicola*, just entering. Enlarged.

Sterilization of the soil by steam is the most efficient measure of controlling the eel-worm, as well as many insect pests ordinarily introduced into the greenhouse with the soil, and various ways of accomplishing this have been devised by hothouse gardeners. Perhaps the earliest record of this soil treatment is that of Mr. W. N. Rudd,\* of Chicago, who used it successfully in 1893. The most practical and economical method with which I am acquainted, is that of Mr. J. F. Ammann, of Edwardsville, Illinois. Into a sterilizing bin of rough boards, measuring two feet high, 10 feet wide, and 20 feet long, about a foot of soil is placed, and a heating apparatus of five "runs" of old perforated two-inch pipe is laid and connected with the steam supply. Another foot of soil is added, and potatoes are placed in the bin, one at each end and another in the center. The bin is then covered with a tarpaulin, and 80 pounds of steam are turned into the pipes for about an hour and a half, or until the potatoes are well cooked.

#### LETTUCE.

The cultivation of lettuce, though carried on throughout the year, is confined to hothouses during the cooler months. The hothouse product is far the most important, and it is to this that insect pests are the most troublesome. Cutworms, the lettuce plant-louse, and the cabbage-worm are usually abundant enough to do it much damage, and need the close attention of the lettuce grower.

\*Killing Grubs in Soil. American Florist (Chicago), Vol. IX, Sept. 28, 1893, p. 171.



## THE VARIEGATED CUTWORM.

*Peridroma margaritosa* Haw. (*Peridroma saucia*, *Agrotis saucia*.)

Young lettuce, cabbage and other plants, are often cut off, or otherwise eaten, by some unseen insect, and later the leaves may be so badly eaten as to ruin them for market. In such cases if one searches near the plant, just beneath the surface of the soil, he is almost certain to find a grayish or dark fleshy cutworm.

The only cutworm I found feeding on lettuce and other vegetables in the greenhouses and out-of-doors in 1908 was the species named above. The egg (Fig. 22, *e*) from which it hatches is about one-fiftieth of an inch in diameter, dome-shaped, with vertical ribs. When first laid it is creamy white with a pearly luster, but it soon changes to a pinkish tint, and finally to lilac or darker. The parent moth may deposit 500 eggs, or even more, in masses of 60 and upwards (Fig. 22, *f*). The larva hatches in five or six days, and after eating the egg shell from which it has emerged, begins feeding on the lettuce leaf. When full grown (Fig. 22, *b*, *c*, *d*) it is about an inch and a half long. It is usually dull, blackish brown, mottled with gray, some larvæ being paler and others darker. A characteristic marking is a row of four to six yellowish dots along the median line of the back. This cutworm feeds at night, and hides during the day in the soil just beneath the surface, or under boards or rubbish near the plant. It remains a cutworm for 25 to 30 days, and then goes into the ground and pupates in an oval earthen cell, usually found just below the surface. Fifteen to nineteen days later it comes out as a moth (Fig. 22, *a*). The pupa is shining reddish brown, growing darker with age. It is about an inch long, slightly pointed at one end and rounded at the other. The moth measures about one and three quarter inches across the expanded wings. The fore wings are brownish, mottled with black or gray, the shades and markings varying considerably. The hind wings are nearly uniform grayish or pale brownish, with a darker border. Like the larva, the moth is nocturnal in habit, and the eggs are laid at night. The adult may live a week or more, but rarely lasts more than ten days. The complete life cycle in summer requires 45 to 54 days, but in winter, in greenhouses, the period is much longer. Out-of-doors there are two generations in a year, and in greenhouses probably four or more. According to various writers the winter may be passed outdoors in either the pupal, larval, or adult stage.

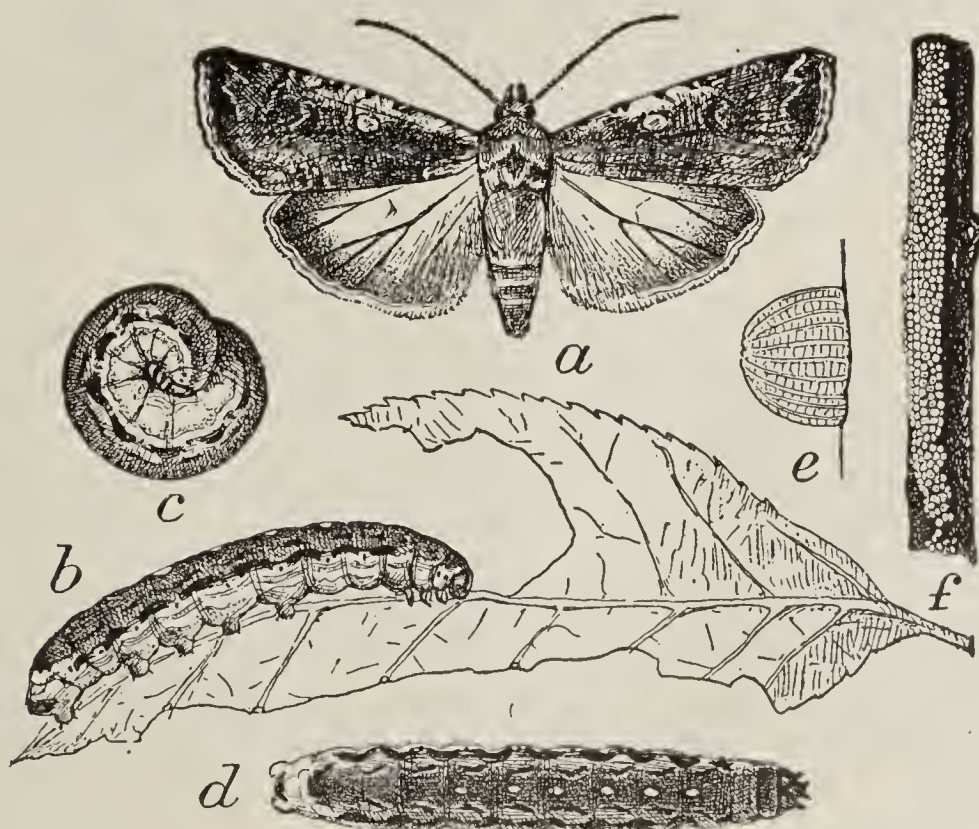


Fig. 22—Variegated Cutworm, *Peridroma margaritosa*: *a*, adult; *b*, larva, side view; *c*, same curled up; *d*, dark-colored larva, seen from above; *e*, single egg; *f*, cluster of eggs on twig. All natural size except egg.



*Natural Enemies*—A single tachinid fly (*Archytes aterrima* Desv.)\* has been bred from this cutworm in Illinois, but three species of these flies and several hymenopterous parasites have been reported to infest it elsewhere. None of these, however, is of much importance in lessening its numbers.

*Remedial Measures*—In the greenhouse, for such vegetables as lettuce, insecticides may best be used in the form of a poisoned bait. Successful experiments against cutworms were made by me in a Chicago greenhouse this year (1908) with both poisoned bran and poisoned lettuce leaves. In lettuce houses the latter will usually be the most convenient. If the soil is new, and especially if it is a sod soil, lettuce leaves should be laid on the beds and dry Paris green sprinkled lightly over them before the crop is planted. Or if the lettuce has already been planted, it should be pulled up if cutworms are abundant, and a row of lettuce leaves should be laid along each side or in the center of the bed, and then poisoned. Even though there are but very few cutworms in the greenhouse, it is always best to repeat this process at the final gathering of each crop. It is but little trouble to lay fresh refuse leaves along the bed and sprinkle them with the poison.

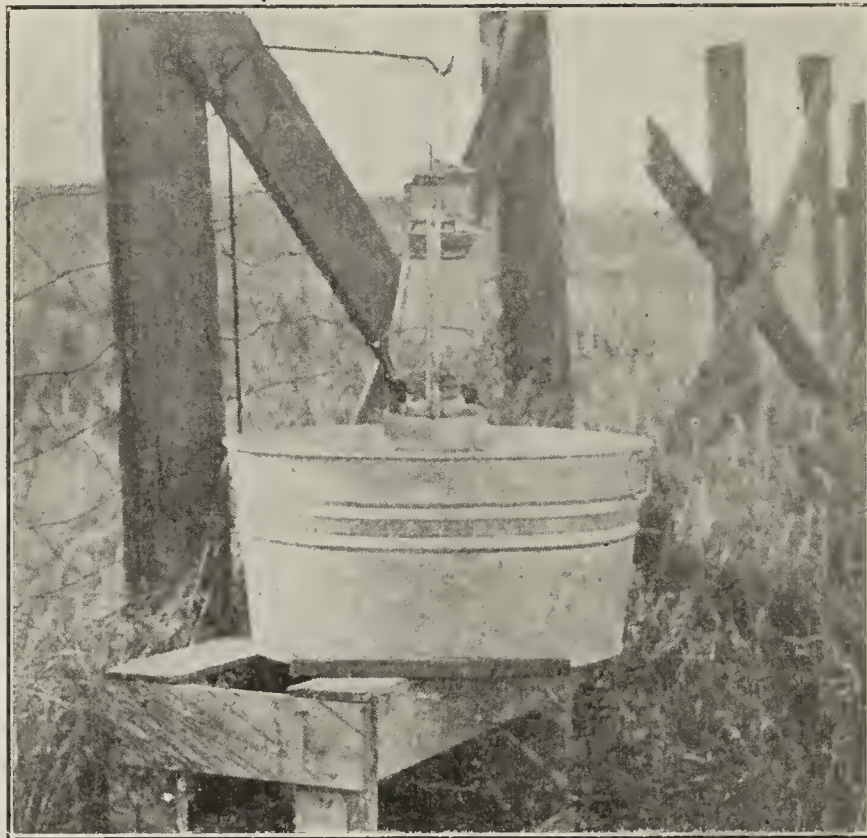


Fig. 23—Trap lantern for adults of cutworm.

A lantern trap (Fig. 23) is also useful in the greenhouse. This consists of a tub with an inch or two of water in the bottom and a little kerosene to form a surface film, and a lantern is hung over the tub to be kept burning for several nights. The moths are attracted by the light, and in flying around it drop into the tub and are killed by the oil.

Outdoor plants, such as cabbages, beets and onions, may be protected by the use of poisoned bran mash, the formula for which is given on page 260. This should be placed in small piles, about a tablespoonful to a pile, at the bases of the plants. When a field which has been in grass is to be planted to vegetables, it is well to use the poisoned bran in spring, shortly before planting the crop.

Dusting or spraying plants with Paris green or arsenate of lead is effective against cutworms and safe for most vegetables, but not for lettuce.

\*Determined by C. A. Hart.



It is often easier to pick, brush, or shake off cutworms than to destroy them by poison.

In agricultural practice, early fall plowing is often helpful if done while cutworms are still actively feeding. Their food being thus destroyed, many will starve, and others will be too weak to survive the winter. On the other hand, if the plowing is delayed until the cutworms have pupated, little or no benefit will follow. Crop rotation may sometimes be useful, but as very few garden plants are unmolested by cutworms, it is not to be relied on. Nevertheless, if it can be avoided the more succulent plants should not be grown in soil known to be infested by cutworms.

Clean culture is, of course, important. Weeds and rubbish afford excellent breeding places for cutworms as well as for many other insects.

#### THE LETTUCE PLANT-LOUSE.

*Macrosiphum lactucae* Kalt. (*Nectarophora lactucae*, *Siphonophora lactucae*, *Aphis lactucae*).

The lettuce-louse is probably to be found in every Illinois greenhouse where lettuce is grown. It often becomes very abundant, especially in the lettuce heads, and not only stunts the plants, but makes the product unsalable because it is impossible to free the heads thoroughly from the lice. I have also found this louse on celery out-of-doors, but never sufficiently abundant to do injury.

Its life history is the same as that of most other plant-lice; that is, the viviparous female reproduces without the intervention of the male, and gives birth to living young. Each louse may produce 50 to 100 young, and because of this great reproductive capacity a greenhouse may be almost overrun before the presence of the insects has been noticed.

*Natural Enemies*—Fortunately, this species, like most plant-lice, is subject to the attacks of many parasitic and predaceous insects which do much to control it. They are seldom capable of holding it completely in check, however, and remedial measures must be resorted to.

*Remedies*—Only remedies to be used in greenhouses need be mentioned, as this louse has not been found by us of economic importance elsewhere.

Fumigation is the only satisfactory remedy. The lice are usually within the heads, making it almost impossible to reach them with a spray; and at any rate the use of an effective spray would probably spoil the lettuce for the market. Tobacco or one of the tobacco extracts, or, better, hydrocyanic acid gas, may be used as a fumigant. The latter is the more effective, and will also destroy the white-fly and the aphids of the cucumber, which plant is usually grown in the same houses with lettuce.

#### THE IMPORTED CABBAGE-WORM.

*Pontia rapae* Linn. (*Pieris rapae*).

Occasionally the cabbage-worm becomes abundant and destructive to greenhouse lettuce, and I have seen beds which were planted the last part of August or the first part of September completely ruined by it. It has been already sufficiently discussed as one of the cabbage insects (pages 220-222).

*Methods of Control*—As arsenicals cannot be used on lettuce, it is hardly probable that the cabbage-worm in greenhouses can be successfully treated by any of the measures advised for its control out-of-doors (pages 221-222). If there are cabbage gardens near a greenhouse, it is not advisable to plant lettuce until the middle or last of September. If, in spite of precautions, a bed becomes badly infested, the plants should be thoroughly sprayed with Paris green, and pulled up within two or three days, after which the bed may be replanted.



## ONION.

With the possible exception of the potato, the onion is the most important garden product of Illinois and its insect enemies are the most difficult to control. In 1899, 2,563 acres were used for the growing of onions in this State, and the acreage has enormously increased since then. There are but two onion pests which are of general economic interest, the onion-maggot and the onion thrips.

## THE ONION-MAGGOT.

*Phorbia ceparum* Meigen. (*Pegomyia cepetorum*, *P. ceparum*, *Anthomyia ceparum*).

Any one who has ever had anything to do with onion-growing is fully aware of the great damage done by the onion-maggot (Fig. 26). As soon as the plant begins to sprout, the work of the maggot begins, and it is at this time that much of the damage is done, although it is not so evident then as later.



Fig. 24—Onion Maggot, *Phorbia ceparum*, female and head of male. Length of body about three-sixteenths of an inch.

Much of the trouble attributed to poor seed is really due to the maggot, which may attack and quickly kill the plants just as they appear above ground, or even sooner. The earlier the attack the greater the number of plants destroyed, since more will be eaten by the maggot.

The adult (Fig. 24) of this maggot is very similar to the common house-fly in general appearance, except that it has a grayish thorax and is somewhat smaller. It is a near relative of the cabbage root-maggot, already described, and the two insects, as well as their work, are much alike. The winter may be passed in any one of its various stages excepting the egg. Hibernating adults, or adults maturing early in spring, deposit eggs deep in the cracks and crevices of the earth, near the young plants. The minute maggots hatching two to four days later, more or less according to the prevailing temperatures, make their way to the bulb and begin feeding on



the roots and the underground parts of the plant. They burrow within the bulb, causing the inner parts to decay. An infested onion may appear sound, but by pressure the rotten parts and the maggots may be forced out. When full grown, some two or three weeks after hatching, the maggots change to brownish oval puparia (Fig. 25) in the bulbs or in the earth not far from the onions in which they have been feeding. These puparia transform to adult flies in about two weeks, and the flies, in turn, deposit eggs for a second generation.

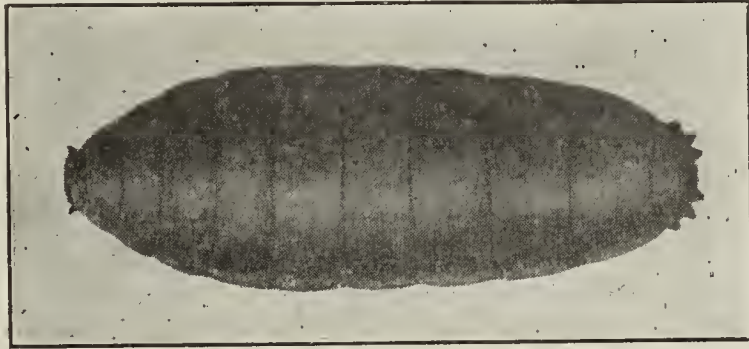


Fig. 25—Onion Maggot, *Phorbia ceparum*, puparium. Length about one-fourth inch.

*Natural Enemies*—The onion-maggot has a few parasitic enemies, but they are seldom numerous enough to hold it in check, and have little economic value in Illinois. Chickens and other domestic fowls are fond of this insect, but on a large onion farm, it would be too difficult and expensive to keep enough of them to be of much assistance.

*Methods of Control*—As this insect often lives over the winter as a maggot or as a puparium in the onion bulb, it is of great importance that the fields should be thoroughly cleaned up in fall, no onions being allowed to remain there over winter.

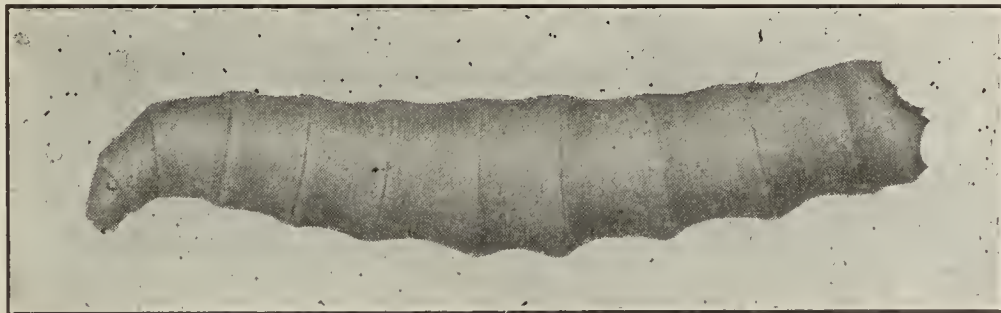


Fig. 26—Onion Maggot, *Phorbia ceparum*, larva, side view. Length about five-sixteenths of an inch.



Fig. 27—Onion Maggot, *Phorbia ceparum*, tip of larva, top and side views. Greatly magnified.

As a rule, this pest is more abundant and destructive on comparatively sheltered areas than in open fields over which the winds have full play. This fact should be borne in mind in locating onion beds.

The amount and kinds of manure used may have an important influence on the damage done by this insect. Prof. C. G. Hewitt, of the University of



Manchester, England, has recently shown\* that *Anthomyia radicum*, a European species very closely related to the onion-maggot, breeds freely in horse manure. It has often been noticed by entomologists and gardeners that fields which have been abundantly manured are worse infested than those where little manure has been used.†

It is much easier to keep these maggots from infesting onions than to kill them after their appearance. The three best repellents and preventives which have been recommended from time to time are hellebore, tobacco dust and dry lime. The first two are discussed under remedies for the cabbage root-maggot, (pages 224 and 225) and on pages 259 and 260. Dry lime may be applied in the same manner as tobacco dust. These substances either repel the fly or prevent the maggot from reaching the plant even though the eggs are deposited. They should be applied about the time the plants are sprouting or just as they appear above ground.

After plants have become infested it is often possible to kill the maggots before they enter the bulb by applying a contact insecticide. Carbolic acid emulsion and a decoction of hellebore (page 259) have given the best results. They should be applied as soon as the maggots are noticed, or at least before they enter the bulbs, otherwise it is impossible to reach them with any insecticide.

Old onions may be used as traps for the maggots, by placing them along the edges of the field in small piles in early spring, before the onion seed has been planted. The flies will be attracted to these decaying onions, which should be destroyed after infestation, particular care being taken to do this before any of the maggots have become adults.

Mr. F. A. Sirrine‡ suggests the following hand method: "To get at the onion maggot after the eggs have been laid, carefully lift all the infested onions and destroy the maggots by crushing or by dipping in kerosene. If this is done early in the season, when their work is first noticed, it will be no more of a task than the process of first weeding."

The use of commercial fertilizers, to force the plants rapidly at first, will greatly lessen the amount of injury by the maggot.

#### THE ONION THRIPS.

##### *Thrips tabaci* Lind.

In July or August one sometimes sees whitened onion plants in numbers sufficient to give the entire field a hoary look. This "white blast," as it is often called, is due to a tiny winged insect, the thrips of the onion, sometimes incorrectly called the "onion-louse," which often appears in great numbers,

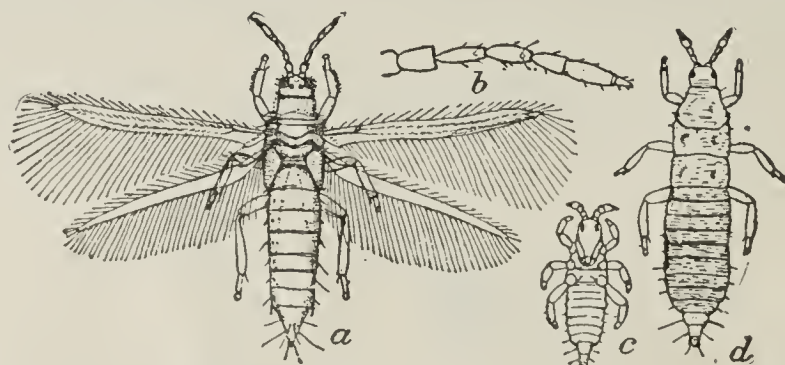


Fig. 28—Onion Thrips, *Thrips tabaci*: a, adult; b, antenna of same; c, young larva; d, full grown larva. All highly magnified.

feeding first at the axils of the leaves. It does not actually eat the leaves, for its mouth parts, which form an inverted cone projecting from the under side of the head, are not of the true biting type. It pierces the epidermis of

\*On the Life-history of the Root-Maggot, *Anthomyia radicum* Meigen, Jour. Econ. Biol., Vol. II, Pt. 2 (Aug. 31, 1907), p. 57; and on the Bionomics of certain Calyptrate Muscidae and their Economic Significance, with especial Reference to Flies inhabiting Houses. Ibid, Pt. 3 (Dec. 11, 1907), pp. 86-87.

†For tests with "blood and bone" see page 17.

‡Maggots and Smut in Onions. Rural New Yorker, May 12, 1900, Vol. 59, p. 334.



the leaf, and by moving the tip of the cone backward and forward it makes an opening, through which it sucks the juices of the plant. Since this thrips is a general feeder, attacking many cultivated plants as well as weeds, it is of great economic importance, not only to the truck gardener but to the florist also. It is often injurious to cabbage and to cucumber plants in greenhouses.

Its eggs are deposited just within the leaf tissue. The young (Fig. 29, c) are very minute at hatching, elongate, and pale yellowish. The adults (Fig. 29, a) closely resemble the young in shape, but differ by their darker color, and usually by the possession of wings. There are several generations a year, the number varying according to the season. The winter is passed in either the larval or the adult stage.

*Natural Checks*—The insect enemies of this thrips are of no importance, but the character of the weather has a noticeable influence on its abundance, wet weather being decidedly to its disadvantage.

*Remedial Measures*—The standard insecticides for thrips are kerosene emulsion and whale-oil soap. Spraying must begin at the first appearance of the insects, and must be repeated in a week or ten days. The most effective indoor remedies are thorough and frequent fumigation with tobacco and tobacco extracts, or with hydrocyanic acid gas.

Clean culture is very important, since thrips hibernate on weeds and grasses along the edge of the onion fields. By plowing up all weedy and grassy land late in fall, after the thrips have left the onions, or by thoroughly burning over such land during the winter, the number of thrips can be greatly diminished. Entire communities should practice these farming methods, for otherwise fields properly cared for may become reinfested from those neglected.

#### GARDEN PEAS.



Fig. 29—Pea-louse, *Macrosiphum pisi*, on stems of red clover. Natural size.



Garden peas are grown to a considerable extent by many of the market gardeners, and one insect pest, the pea-louse, has been found to do great injury to this crop in Illinois.

#### THE PEA-LOUSE.

*Macrosiphum pisi* Kalt. (*Nectarophora destructor*, *Siphonophora pisi*, *Aphis pisi*).

This plant-louse (Fig. 29) is common in all parts of the United States, and is a pest of some importance in Europe, its original home. Its life history is not unlike that of plant-lice already described. The adult is about



Fig. 30—Pea-louse, *Macrosiphum pisi*, wingless viviparous female. Greatly magnified.

the size of a pin-head, or a little larger, pale green, and soft. It may be winged (Fig. 31) or wingless (Fig. 30). The winter is passed either in the egg or the adult stage, and usually on clover, from which it migrates to the pea in spring, sometimes multiplying enormously on this crop.



Fig. 31—Pea-louse, *Macrosiphum pisi*, winged viviparous female. Greatly magnified.



*Natural Enemies*—Many parasitic and predaceous insects prey on the pea-louse and materially aid in checking its rapid multiplication, the parasites not infrequently becoming numerous enough to control it completely. (Fig. 32.)



Fig. 32—Pea-louse, *Macrosiphum pisi*, empty skin after the emergence of a winged parasite. Greatly magnified.

*Remedial Measures*—Sprays of kerosene emulsion or whale-oil soap solution are probably the best remedies known. They should be applied at the first appearance of the lice, and continued as needed.



Fig. 33—Pea-louse, *Macrosiphum pisi*, attacked by fungus. Greatly magnified.

The brush and cultivator method is also much used. With this in view the peas must be planted in rows at least two feet apart. As soon as the lice infest the vines, and at intervals subsequently, they are brushed from the vines and covered by a cultivator before they can get back. Brooms made of fresh-cut pine branches have been suggested for brushing the lice from the vines.



## POTATO.

The potato is the most important vegetable grown in Illinois, both in acreage and value of the crop. Though it is attacked by a number of insect pests, none are of much economic importance in this State except the Colorado potato-beetle, the wireworms, the flea-beetles, and the potato plant-louse. The stalk-borer (*Papaipema nitela*) is also occasionally injurious to this crop. For a discussion of this insect see pages 254-255.

## THE COLORADO POTATO-BEETLE.

*Leptinotarsa 10-lineata* Say. (*Doryphora 10-lineata*.)

This common and injurious species has doubtless caused greater damage to potatoes in Illinois than any other insect, and it is found on the vines in destructive numbers every year. It is a western species, its original habitat being the Rocky mountain region. Its native food consisted of wild plants closely related to the potato, and when potato-culture reached its native prairies it promptly availed itself of the increased food supply thus afforded. It began its migration eastward by way of the potato fields about the year 1860, reaching Illinois some fifteen years later. Except in the Pacific coast region, it is now found generally distributed throughout the United States and Canada, wherever the potato is grown.



Fig. 34—Potato Beetle, *Leptinotarsa 10-lineata*: a, eggs; b, larvæ, young and full-grown; c, pupa; d, adults; e, wing-cover of adult; f, hind leg of adult. Natural size except e and f.

The yellow and black striped beetle (Fig. 34, d, d) passes the winter in the ground, and makes its appearance early in spring. It feeds at first on the young potato plants if these are at once available, or, if not, on some one of its wild food-plants. The sexes soon mate, and the clusters of bright yellowish-orange eggs (Fig. 34, a, a) are deposited on the under side of the leaves. Each cluster may contain from 25 to 75 eggs, or even more, and individual beetles have been known to lay as many as 3,000 eggs under certain artificial conditions. The average number, however, is about 450.\* The fleshy, grub-like larvæ (Fig. 34, b, b, b) hatch in four to seven days and at once begin to eat the potato leaves. They are dark red when hatched, but gradually become paler as they grow, with two rows of blackish spots along each side of the body. When two or three weeks old they go into the

\*Further Biological Notes on the Colorado Potato-beetle, *Leptinotarsa decemlineata* (Say), by Alec. Arsène Girault. *Annals Ent. Soc. America*, Vol. I, No. 2 (June, 1908), p. 158. Columbus, Ohio.



ground for pupation, emerging as beetles one or two weeks later. These beetles may feed and then go into hibernation, or eggs may be deposited for another generation. The number of generations is still in dispute, but there is probably but one as a rule, only a few of the beetles first to emerge laying eggs for a second generation the same year.

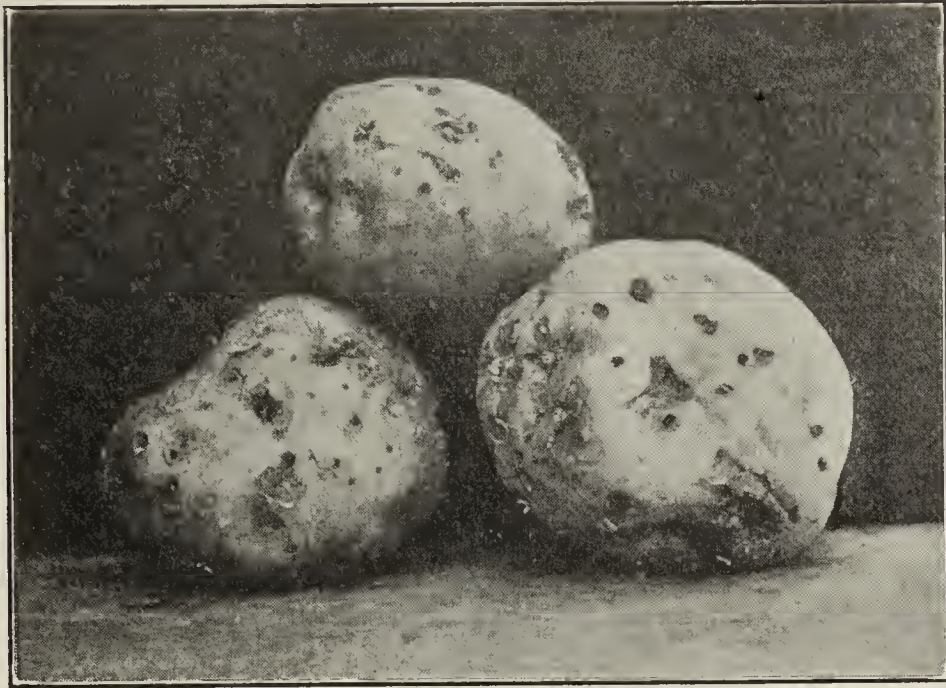


Fig. 35—Potatoes showing injury by wire worms, *Limonius confusus*.

*Natural Enemies*—Insects enemies of the potato-beetle are not uncommon, but it is doubtful if in Illinois they ever play any considerable role in reducing its numbers. Its commonest parasite in the vicinity of Chicago was a Tachina fly—*Phorocera rufilabris* V. d. W.\* The white eggs of this fly were common on the backs of both beetles and larvæ—on the thoracic plate of the adult, and between the thoracic segments of the larva. The maggots hatching from these eggs enter the bodies of the beetles or the larvæ, soon killing them. Many predaceous enemies are known, including soldier-bugs, robber-flies, spiders, ground-beetles, ladybirds, tiger-beetles, rove-beetles, and some native birds and the domestic fowls.

*Methods of Control*—The two standard remedies for injuries by this pest are Paris green and arsenate of lead. In Illinois, dry Paris green, with or without lime or flour, is used by nearly all potato growers. It has the advantage of being easy to prepare and apply, but there are offsetting disadvantages which make it less desirable than Paris green in water. It is less adhesive than the fluid spray, and hence must be applied more frequently and more labor is required. The dry poison is very injurious when breathed into the lungs by the person applying it. Bordeaux mixture should always be added to Paris green when it is applied in water—as also to the arsenate of lead—for this compound spray is more effective against flea-beetles, and is a remedy for blight. Furthermore, the lime in the Bordeaux unites with the Paris green, thus increasing its adhesiveness, and it changes the soluble arsenic to insoluble, thus preventing the burning of the foliage which often follows when Paris green is used alone. The method of preparation is given on page 60. The potato patch, and indeed the entire farm, should be kept free from weeds of the nightshade family, for the potato-beetle can breed on these.

\*Determined by C. A. Hart.



## WIREWORMS.

*Limonius confusus* Lec.

But one kind of wireworm has been found by us common enough in Cook county to require special mention, but this single species is very injurious there to potatoes (Fig. 35, 36), radishes, onions, turnips, tomatoes, cabbage, corn, and horseradish. It burrows into or devours the roots and tubers of these vegetables, thus often completely ruining the crop. With the exception of the onion, tomatoes, cabbage, and corn, the plants above mentioned give no evidence above ground of the presence of wireworms, their attacks seldom weakening the plant, but merely disfiguring the marketable part.

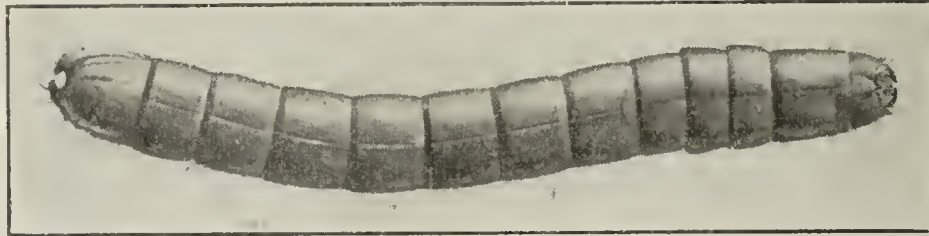


Fig. 36—Wireworm, *Limonius confusus*, larva. Length about three-fourths inch

*Remedial Measures*—Three methods of control are practiced: rotation of crops, fall plowing, and poisoned baits. Cropping for two years with some vegetable which is virtually immune, such as beans, peas, spinach, cucumber, melon, rhubarb, lettuce, or pepper, should rid the soil of wireworms.\*



Fig. 37—Wireworm, *Limonius confusus*, tip of larva, seen from above. Greatly magnified.

Late summer or fall plowing is frequently resorted to in order to destroy the pupæ and beetles. The land should be cultivated thoroughly several times in the fall.

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\*This list is given on the authority of those who have reported these plants to be practically uninjured by wireworms, even when the latter are present in the soil.



Trapping the adults by poisoned baits is a method sometimes used in the eastern states. Sliced potatoes, wads of green clover, or corn-meal dough, poisoned with Paris green, have been found effective.\*

These baits should be placed under boards in various parts of the field, and renewed once or twice a week during the spring and early summer.



Fig. 38—Wireworm, *Limonius confusus*, adult beetle. Length about three-sixteenths inch.

#### THE POTATO FLEA-BEETLE.

*Epitrix cucumeris* Harr. (*Crepidodera cucumeris* Harr.)

Potato leaves are often riddled with small holes as if they had been the target for a discharge of shot. Such injury is the work of flea-beetles. The life history and habits of the potato flea-beetle (Fig. 39) are essentially the same as those of the cabbage flea-beetle, which is discussed on pages 227-228.



Fig. 39—Potato Flea-beetle, *Epitrix cucumeris*, adult. Enlarged as indicated.

**Remedies**—The best remedy is spraying with Paris green, or arsenate of lead, and Bordeaux mixture, as recommended for the potato-beetle (page

\*Our own experiments the past year with poisoned baits for this insect were not sufficiently effective to pay for the labor and materials.



250). Potatoes may be thus protected against the potato-beetle, the flea-beetle, and the blight. Other remedies applicable to this pest may be found on pages 227-228.

#### THE POTATO PLANT-LOUSE.

*Macrosiphum solanifolii* Ashm. (*Nectarophora solanifolii*, *Siphonophora solanifolii*).

The potato plant-louse is often a very troublesome species, densely infesting the tops of the plants and soon stunting or even killing them. It is so much like the notorious and destructive pea-louse that the two species cannot be distinguished without a closer examination than the ordinary observer is likely to make. Although commonly pale greenish, there is a red variety of this species which, during the summer, is often as abundant as the commoner green form. The life history and natural enemies of this aphid are similar to those of other plant-lice already described.

*Remedial Measures*—The only available remedies are those suggested for other plant-lice; namely, kerosene emulsion and soap solutions (pages 258 and 259)..

Clean culture seems to be of much importance, inasmuch as the eggs are deposited in fall on shepherd's-purse and possibly on various other weeds.\*

Fall plowing and burning over grassy and weedy areas in the neighborhood of potato fields are certainly to be recommended; and Miss Patch further commends, as a precaution, the practice of burning old potato stalks, since belated specimens of the plant-lice may possibly remain on them under certain conditions.

#### SPINACH.

Spinach is often attacked in fall by a plant-louse which sometimes destroys entire fields.

#### THE OMNIVOROUS PLANT-LOUSE.

*Myzus persicae* Sulz. (*Rhopalosiphum dianthi*, *Aphis dianthi*.)

In the fall of 1908 my attention was attracted to the great abundance of a plant-louse infesting spinach on many truck farms near Chicago. This louse may feed on almost any plant, as the common name above given implies. Among the vegetables which it sometimes injures, weakening the plants and causing a curling of the leaves, are turnip, radish, celery, cabbage and cauliflower. It is impracticable to wash off these green lice after they become abundant, and the presence of thousands of them on the spinach renders it unsalable.

*Remedies*—The only practicable remedy is thorough spraying with a contact insecticide which will not give a permanent odor or taste to the leaves. The standard tobacco or nicotine extracts (page 260) answer the purpose. It is very important that spinach should be closely watched, and that the plants be sprayed at the first appearance of the lice. The treatment should be repeated at intervals as may be necessary.

#### TOMATO.

Although not extensively grown in the truck-gardens of Cook county, the tomato is of much importance in other parts of the State, particularly as supplied to canneries. A stalk-borer (*Papaipema nitela*) is the principal insect enemy of the crop in Cook county, and is no doubt the cause of more damage than is commonly charged to it. To the casual observer there is no indication of the presence of these insects when the plants wilt and die from

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\*According to Miss Edith M. Patch. See "The Potato Plant Louse." Bull. Maine Agr. Exper. Station, No. 147 (Nov., 1907), pp. 247-248. Orono, Me.



its attack, and as a rule the gardener is at a loss to find the cause, the characteristic round hole in the stalk being easily overlooked. Occasionally the Colorado potato-beetle, treated on pages 249-250, damages tomatoes soon after transplanting to the field.

#### THE STALK-BORER.

*Papaipema nitela* Guen. (*Hydroecia nitela*, *Gortyna nitela*.)

This borer, or "heart worm," as it is often called by corn growers, was found destructive to tomato and corn, and occasionally to potato, in a number of restricted areas during the past year. Other vegetables known to be injured by it are rhubarb, spinach, cauliflower, eggplant, and pepper.

The presence of this caterpillar in the tomato plant is indicated by the wilting or death and final breaking down of the top, and by the presence of a round hole in the side of the stalk, from which a brownish excrement is

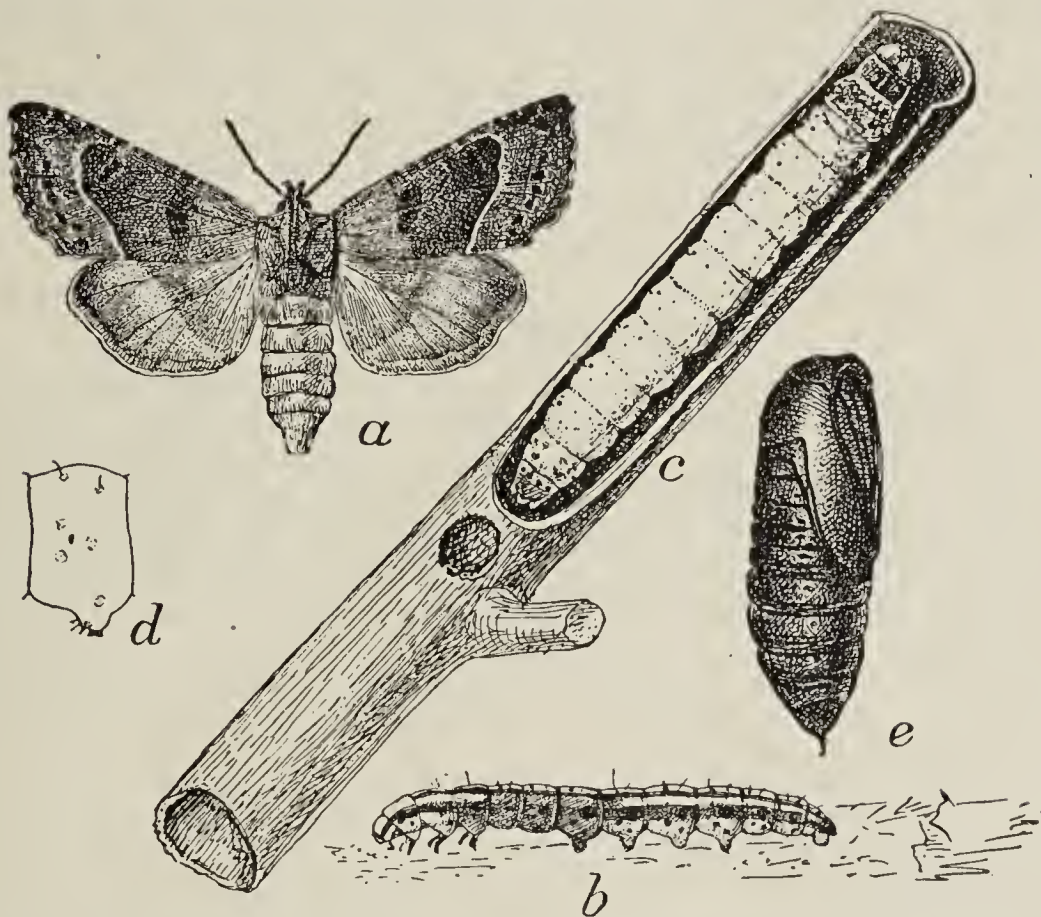


Fig. 40—Stalk-borer, *Papaipema nitela*: a, adult; b, half-grown larva; c, mature larva in burrow; d, side of one of its segments; e, pupa. Slightly enlarged.

oozing. Upon careful examination of plants so injured a peculiarly striped larva (Fig. 40, b) will usually be found in the stalk. The following description is quoted from Professor Forbes.\*

The larva may be readily recognized "by the peculiar break in the striping of the body at the middle \* \* \* (Fig. 40, b) giving it an appearance as if it had been pinched or injured there. It is about an inch long when full grown. The general color varies from purplish brown to whitish brown, according to age, and it is marked with five white stripes, one running down the middle of the back, and two on each side \* \* \*. The stripes nearly vanish as the larva matures (Fig. 40, c). The head and top of the neck, and the leathery anal shield at the opposite end of the body are light reddish yellow with a black stripe on each side."

The young caterpillar first feeds within the stems of grasses or weeds, but as it becomes larger it is compelled to seek thicker-stem plants, and it

\*Twenty-third Rep. State Ent. Ill., pp. 44, 45."



is at this time that it begins to infest garden vegetables. In northern Illinois, in 1908, half grown larvæ were found in tomato stalks the middle of June, when fully half the plants in the field had been killed by them. The larva usually enters the stem near the base and burrows upwards. When full grown it changes into a reddish brown pupa (Fig. 40, *e*) within the stalk, usually below the original entrance hole, and later the grayish moth (Fig. 40, *a*) emerges. According to Prof. F. L. Washburn\* the eggs of this moth are deposited in masses on the stem of the plant near its base. It is supposed that they are laid in grass lands in fall, and that they hatch the same season or the following spring.

*Economic Procedure*—After plants have become infested, no remedy can be used to save those individual plants, and they should be pulled up and burned immediately to prevent the larvæ from entering other plants, and also to decrease the number of the borers for the next year.

In spring, vegetation around tomato, potato, and corn fields should be watched, and if it is wilting or dying it should be examined to learn if this borer is present, in which case the weeds should be cut and destroyed without delay.

Late fall plowing of infested fields is advised in order to bury the eggs, which, as already said, are supposed to be laid in grass or weedy land in fall, and all weeds, not only in the fields but along the roadsides adjoining them, should be destroyed at this time.

#### PREPARATION OF INSECTICIDES FOR USE AGAINST INSECTS INJURIOUS TO GARDEN AND HOTHOUSE VEGETABLES.

From the economic point of view insects are divisible into two classes; those which chew and swallow the tissues of the plant, and those which suck their juices. Insects of the first class—cabbage-worms, potato-beetles, and cutworms, for example—can usually be destroyed by one of the so-called stomach poisons enumerated below; but those of the second class—plant-lice, thrips, the white-fly, etc.—are unharmed by such insecticides because they take their food from the interior of the plant, and so a contact insecticide must be used.

The classification in the following synoptical list of insecticides is based on their most obvious distinctions, and the subsequent treatment corresponds to the order of the list.

##### *Dust or Liquid Sprays*

| Stomach poisons—for biting insects.                   | PAGE. |
|-------------------------------------------------------|-------|
| Paris green, dry, with or without an adulterant ..... | 256   |
| Paris green, liquid spray .....                       | 256   |
| Arsenate of lead .....                                | 256   |
| Resin-lime mixture, with a poison .....               | 256   |
| Bordeaux mixture, with a poison .....                 | 257   |
| Contact insecticides—for sucking insects              |       |
| Kerosene emulsion .....                               | 258   |
| Whale-oil soap solution .....                         | 259   |
| Carbolic acid emulsion .....                          | 259   |
| Hellebore decoction .....                             | 259   |
| Insect powder (pyrethum or buhach) .....              | 259   |
| Tobacco and nicotine preparations .....               | 260   |
| Lye-sulphur wash .....                                | 260   |

##### *Poisoned Baits—for biting insects*

|                                         |     |
|-----------------------------------------|-----|
| Poisoned bran mash .....                | 260 |
| Poisoned lettuce or clover leaves ..... | 260 |

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\*Preliminary Report upon Work with the Stalk Borers in Minnesota. 12th Rep. State Ent. Minn., p. 151, Dec., 1908.



| <i>Repellants</i> —for any insects | PAGE. |
|------------------------------------|-------|
| Carbolic acid and lime .....       | 260   |
| Tobacco dust .....                 | 260   |
| Lime, dry .....                    | 261   |
| Bordeaux mixture .....             | 257   |
| <i>Fumigants</i> —for any insects  |       |
| Hydrocyanic acid gas .....         | 261   |
| Carbon bisulfid .....              | 262   |
| Sulphur .....                      | 263   |
| Tobacco stems .....                | 263   |
| Nicotine preparations .....        | 263   |

#### PARIS GREEN—DRY.

Unmixed Paris green may be sprinkled upon plants, but the danger of burning the leaves is lessened by adulterating it with flour, land-plaster, or air-slacked lime in the proportion of one pound of the poison to twenty-five pounds of flour or to fifty pounds of land-plaster or lime.

Apply thoroughly and evenly with a hand “dust-sprayer” early in the morning, when the dew is on the plants.

#### PARIS GREEN—LIQUID SPRAY.

##### *Formula.*

|                     |     |         |
|---------------------|-----|---------|
| Paris green .....   | 1   | pound   |
| Unslaked lime ..... | 1½  | pounds  |
| Water .....         | 150 | gallons |

Slake the lime and add the Paris green, thoroughly mixing before adding the water. The mixture must be kept well stirred while it is being sprayed, and most spray-pumps have an attachment for this purpose. The liquid spray is safer and more efficient than either of the dry mixtures previously mentioned.

#### ARSENATE OF LEAD.

Arsenate of lead can be made by properly combining lead acetate and arsenate of soda, but it is difficult to make a good grade of it, and unless large quantities are needed it is best to purchase standard brands, which are ready for use when dissolved in water.

The price of arsenate of lead is less than that of Paris green, but as one must use two to three times as much of it to secure a desired result, it is slightly more expensive as an insecticide than Paris green. This fact is offset, however, by the following advantages which arsenate of lead has over all other arsenicals: it is much more adhesive, remaining on the foliage for a period during which two or three sprayings with Paris green would be necessary; it remains in suspension better; it shows on the foilage; and it is harmless to vegetation, this last fact being of special advantage when the more tender plants are sprayed.

Care should be taken to obtain a good grade, for there are many worthless brands on the market. Usually a good grade can be obtained from any reliable wholesale druggist. As the strengths of the various brands differ, the gardener should follow the directions accompanying the arsenate he is to use.

#### RESIN-LIME MIXTURE.

The resin-lime mixture serves as a stock solution to which poisons may be added. It is valuable chiefly because of its adhesive properties, being for this reason well suited to smooth leaves, such as those of the cabbage. It has the disadvantage, however, that considerable time is necessary for its preparation, and that it is especially liable to clog the spray-nozzle. It is prepared as follows:



*Stock Solution.*

|                                           |           |
|-------------------------------------------|-----------|
| Pulverized resin .....                    | 5 pounds  |
| Concentrated lye .....                    | 1 pound   |
| Fish oil, or any animal oil except tallow | 1 pint    |
| Water .....                               | 5 gallons |

Place the resin, oil, and a gallon of hot water in an iron kettle and heat until the resin is softened, after which the lye should be added to the heated mixture and the whole thoroughly stirred. Then add the remaining four gallons of water and boil for about two hours, or until it will unite with cold water and make a clear, amber-colored liquid. If there is less than five gallons of the preparation, add water enough to make that quantity. This stock solution will keep indefinitely, and the quantity needed for the whole season may be made up at one time.

*Preparation for Use.*

|                      |                     |
|----------------------|---------------------|
| Stock solution ..... | 1 gallon            |
| Water .....          | 16 gallons          |
| Milk of lime* .....  | 3 gallons           |
| Paris green .....    | $\frac{1}{4}$ pound |

First add the water to the stock solution, mixing thoroughly; then add the milk of lime; and, finally, add the Paris green, previously stirred up with water to form a thin paste. The whole mixture must then be thoroughly stirred. This preparation should be made up as needed, for if allowed to stand any considerable time it will settle, and will also gum up the pump valves and the nozzles.

**BORDEAUX MIXTURE AND PARIS GREEN.**

Bordeaux mixture is primarily a fungicide; but it is also useful as a repellent against some insects, and with Paris green or arsenate of lead it makes an excellent combination spray to be used when both fungi and leaf-eating insects are to be dealt with on the same crop.

Various strengths of the Bordeaux are used by the vegetable gardener according to the plants to be sprayed. Those in commonest use are often conveniently designated as 4:4:50, and 6:6:50. The significance of the figures is evident from the following 4:4:50 formula:

|                       |            |
|-----------------------|------------|
| Copper sulphate ..... | 4 pounds   |
| Quicklime .....       | 4 pounds   |
| Water .....           | 50 gallons |

For such plants as asparagus, tomatoes, and melons, the 4:4:50 strength is used; and for the potato and related plants, the 6:6:50.

To make the Bordeaux mixture, dissolve the copper sulphate in about 20 gallons of water—best done by placing the sulphate, or bluestone as it is often called, in a gunny sack or other stout cloth bag and suspending it in the water. It will dissolve in a day or so, and if covered to prevent evaporation it will keep indefinitely. If less than 50 gallons of the Bordeaux mixture is needed, or if the solution is wanted immediately, the bluestone may be readily dissolved in hot water.† In another vessel slake the lime, adding the water slowly, to obtain a smooth, creamy liquid, using barely enough water to cover the lime after it has settled. In this condition, if evaporation is prevented, it will, like the copper-sulphate solution, keep indefinitely.

When ready to spray add enough water to each stock solution, separately, to make 25 gallons, stir each thoroughly, and then mix the two together. This may be done by having the barrels containing the two solutions on a

\*Milk of lime is made by slaking stone lime and adding sufficient water to make a thin whitewash.

†Copper sulphate, either dry or in solution, corrodes iron, and a wooden, earthen, brass, or copper vessel should be used.



high support, with plugs near the bottom so that both solutions can be run into a third vessel below, the operator stirring the fluids as they unite. Or, if such an apparatus is not obtainable, the mixture may be made by pouring the two fluids together from buckets (Fig. 41).

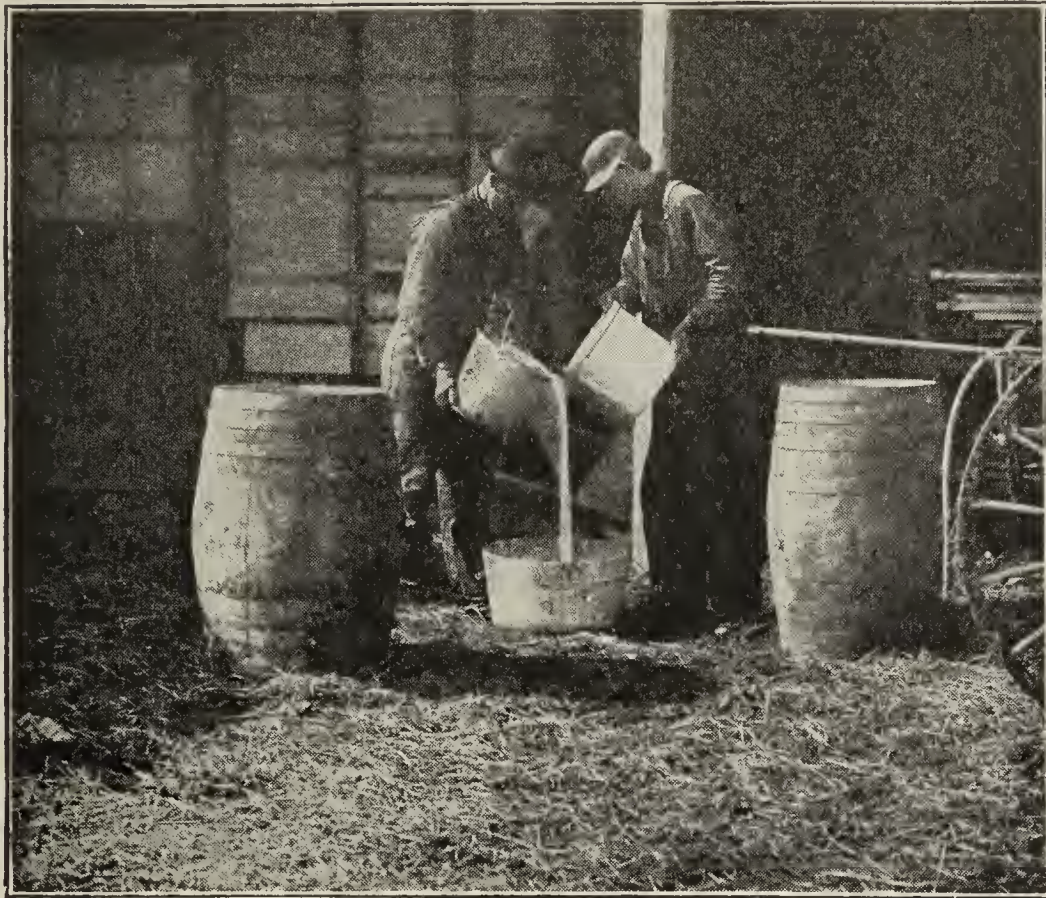


Fig. 41—Method of preparing Bordeaux mixture by hand.

For the combined fungicide and insecticide, add five or six ounces of Paris green, previously made into a paste with water, to fifty gallons of Bordeaux mixture, and thoroughly stir. If arsenate of lead is used in place of the Paris green, about four or five times as much will be required.

Although the separate solutions of the copper sulphate and of the lime are stable, they are not so when combined, and therefore only the quantity to be used at the time should be made up.

#### KEROSENE EMULSION.

*Stock Solution (66 per cent kerosene).*

|          |       |           |
|----------|-------|-----------|
| Soap*    | ..... | ½ pound   |
| Kerosene | ..... | 2 gallons |
| Water    | ..... | 1 gallon  |

If hard soap is used, cut it into fine shavings and dissolve in boiling water, after which remove from the fire and immediately add the kerosene and thoroughly mix. This may be done most easily by churning for about ten minutes with a force-pump, the nozzle being turned back into the liquid; or, in the absence of a pump, the liquid may be turned from one bucket to another for fully ten minutes, holding the bucket high so as to give force to the falling liquid. When thoroughly emulsified it will have the consistency of thick cream, and the oil will not separate out. There is great danger of injuring the plants if the mixture is not well and thoroughly made.

\*Either hard or soft soap may be used. Whale-oil soap and "Tak-a-nap" soap have given excellent results.



For spraying vegetation the stock solution should be diluted to the desired strength. For a five per cent emulsion add 37 gallons of water to 39 gallons of the stock solution; for a 10 per cent emulsion add 17 gallons of water to the same; and for a fifteen per cent emulsion add 10½ gallons.

It is desirable to use soft water both for the stock and as a diluent, but if this is not obtainable the water should be softened by adding lye or sal-soda.

The emulsion should be applied to plants with a spray-pump, and in a fine mist-like spray. For most insects a ten per cent emulsion is strong enough.

#### WHALE-OIL SOAP SOLUTION.

Whale-oil soap is an effective insecticide for plant-lice and other soft-bodied insects. For use, dissolve one pound of the soap in six to eight gallons of hot water.

#### CARBOLIC ACID EMULSION.

Carbolic acid emulsion is a contact insecticide, and also acts as a repellant, being chiefly used for the treatment of root-infesting insects.

##### *Stock Solution.*

|                                               |       |          |
|-----------------------------------------------|-------|----------|
| Hard soap (preferably "Ivory" or "Tak-a-nap") | ....  | 1 pound  |
| Soft water                                    | ..... | 1 gallon |
| Crude carbolic acid                           | ..... | 1 pint   |

Dissolve finely shaved soap in boiling water, add the carbolic acid, and churn as for kerosene emulsion. For use, one part of the stock solution is diluted with thirty to forty parts of water.

#### HELLEBORE DECOCTION.

For use against root-maggots, this decoction is prepared by steeping two ounces of white hellebore in one gallon of hot water for 30 minutes. For insects infesting the foilage, one ounce of hellebore to two gallons of water is sufficient. Hellebore very soon loses its insecticidal properties by exposure to the air, and care should be taken to obtain only such as is known to be fresh.

#### INSECT POWDER (PYRETHRUM, OR BUHACH).

Pyrethrum, or insect powder, as this insecticide is commonly called, is of special value for killing certain kinds of insects, and it has the advantage of being harmless to human beings and the higher animals. On the other hand, its expense prohibits its use on a commercial scale, and it quickly loses its virtue when exposed to the air. If used in a dry form it should be mixed with twice its weight of common flour, and kept in a tightly closed vessel for 24 hours before using. It may be applied with a dust sprayer or some sifting apparatus. A decoction of pyrethrum may be made by mixing one ounce of the powder with enough water to form a thin paste and allowing it to stand several hours, after which sufficient water should be added to make two gallons. This is less effective than the dry powder.

In purchasing pyrethrum, only hermetically sealed cans of it are safe, for the reason already given, but if they can not be obtained care must be taken to buy only an absolutely fresh article.



## TOBACCO DECOCTION AND NICOTINE PREPARATIONS.

Tobacco decoction, although not so effective as some of the above-mentioned contact insecticides, is still used by many for killing soft-bodied insects, such as plant-lice. It is prepared by steeping tobacco stems in hot water at the rate of one pound to two to three gallons.

More reliable than the above, are various commercial preparations which likewise have nicotine as their active principle. (See page 263.)

## LYE-SULPHUR WASH.

This contact spray is said to have particular value against the red spider. It is prepared by mixing five pounds of flowers of sulphur with cold water and then adding to this sulphur paste two and a half pounds of pulverized caustic soda. Water is added from time to time, to prevent burning, until a concentrated solution of five gallons is obtained. One gallon of this stock solution is sufficient for 25 gallons of spray.

## POISONED BRAN MASH.

|                   |           |
|-------------------|-----------|
| Bran .....        | 16 pounds |
| Paris green ..... | 1 pound   |

Slightly dampen the bran and add the Paris green, mixing until every particle of the bran bears some of the poison. The bran should be barely wet enough to make the powder adhere to it, as experiments in green-houses strongly indicate that a soggy mash is not freely eaten by cutworms. A little salt in the water used is said to give the mixture additional relish.

## POISONED LETTUCE OR CLOVER LEAVES.

Small lots of lettuce or clover are poisoned with Paris green, either dry or suspended in water, and the poisoned vegetation is then cut or mowed, and scattered over the infested tract (see page 241). This and the poisoned bran mash seem to be about equally effective.

## CARBOLIC ACID AND LIME.

A coating of the soil at the base of the plants with carbolic acid and lime has been recommended by Dr. John B. Smith\* as "the most effective material tested," in his experiments against the onion-maggot in New Jersey.† To make the mixture, slake three pints of lump lime in a gallon of water, and add one tablespoonful of crude carbolic acid. When applied properly along the rows with a sprinkling-can or spray-nozzle, a thin crust will form on the ground around the plants, which is said to serve the same purpose as the tarred felt-paper protectors described on page 224.

## TOBACCO DUST.

Tobacco dust has been recommended as a useful repellant, particularly against such insects as root-maggots and cucumber-beetles. It has the further advantage of serving as a contact insecticide and as an excellent fertilizer. Indeed, it is said that its value as a fertilizer alone is sufficient to cover its cost.

For leaf-eating insects it is dusted on the leaves early in the morning, while the dew is on. For root-feeding insects it is sprinkled along the rows at the base of the plants, preferably when the soil is moist.

\*The Cabbage and Onion Maggots. Bull. N. J. Agr. Exper. Station, No. 200 (Feb. 12, 1907), pp. 16-19.

†For reference to our own experience with it see page 224.



### DRY LIME.

Fresh air-slaked lime or quicklime when used as a repellent for root-maggots is sprinkled along the rows close about the plants, and acts similarly to the carbolized-lime application. As some insects of economic importance are attracted to manures, the latter should be sprinkled over with lime where there is danger of infestation by insect pests.

Dry lime, especially when fresh, is strongly caustic, and is therefore valuable as a contact insecticide for slugs, plant-lice, and soft-bodied insects generally.

### HYDROCYANIC ACID GAS.

Hydrocyanic acid gas is doubtless the most powerful and effective fumigant known. Indeed, many are afraid to handle the deadly gas; but it can be used with perfect safety if proper care be taken.

It is impossible to give a set formula for its use, owing to differences in the structure of greenhouses. In those of average tightness I have used it on cucumber plants, without injury to them, at a strength of 1 ounce of potassium cyanide to 3,000 cubic feet of space—fumigating in the evening, and keeping the house closed over night.

The materials necessary for fumigation with hydrocyanic acid gas are potassium cyanide (98 to 99 per cent pure), commercial sulphuric acid, and water; and the requisite utensils are half-gallon or gallon jars—stone, earthen, or granite—and a supply of ordinary small paper bags.

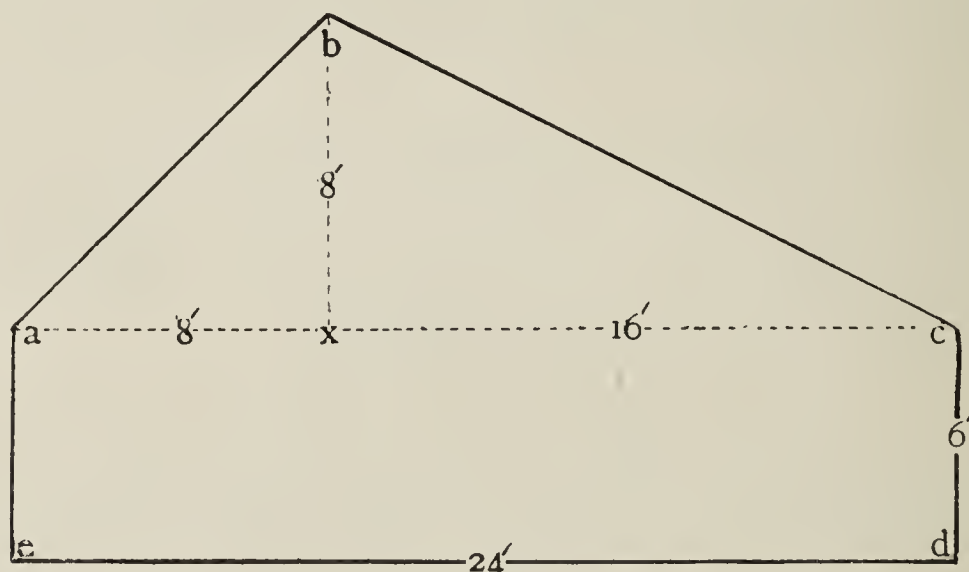


Fig. 42—Diagram illustrating determination of cubic contents of greenhouse.

The number of cubic feet in the house should first be accurately calculated. The method of doing this may be illustrated by a simple computation based on the dimensions given in the accompanying figure, the understanding being that the length of the greenhouse is 100 feet. (Fig. 42.) The cubic contents of the rectangular section of the house,  $a c d e$ , equals  $24 \times 6 \times 100 = 14,400$  cubic feet; that of the triangular section  $a b x$ , equals  $8 \times 8 \times 100 \div 2 = 3,200$  cubic feet; and that of the other triangular section,  $b c x$ , equals  $8 \times 16 \times 100 \div 2 = 6,400$  cubic feet. The cubic contents of this house are, therefore,  $14,400 + 3,200 + 6,400 = 24,000$  cubic feet. Assuming this house to be of no more than the average tightness, we may safely use potassium cyanide at the rate of one ounce to every 3,000 cubic feet of space, and 24,000 divided by 3,000 gives 8 as the number of ounces required in this illustrative case.

The next procedure is to prepare the materials for use and to place the jars in the house. For every ounce of the potassium cyanide used, two ounces of sulphuric acid and four ounces of water are required. Two ounces of the cyanide is about the right quantity for each jar, therefore, for a house of the above dimensions four jars should be placed at equal intervals along the aisles, and the eight ounces of cyanide divided into four equal parts,



and each part put into one of the paper bags. These are used not only for convenience in handling the cyanide when placing it in the jars, but also because they slightly delay the action of the sulphuric acid upon it, thus giving the fumigator ample time to leave the house before the reaction occurs. The jars being in place and the cyanide properly weighed and bagged, the next step is to close all the ventilators in order to prevent any avoidable escape of gas. The water—four liquid ounces to every avoirdupois ounce of cyanide—is then placed in each jar, the sulphuric acid—half as much as the water—is added, and as soon after as possible the bags of cyanide should be put into the jars and the house vacated immediately. Doors should be locked and labels posted indicating the danger. No one should enter the house until it has been thoroughly aired by opening the side doors, and, if convenient, the ventilators also. It is best to fumigate in the evening, keeping the house closed till morning. I have never found a greenhouse so tight that the fumes would remain in it in dangerous quantities all night; nevertheless, it is safest to air the house well before entering.

*Precautions and Miscellaneous Directions*—As cyanide of potassium is a powerful poison it should be handled as little as possible. It should be kept in tightly closed cans or jars, plainly labeled, where it will be inaccessible to persons not acquainted with its poisonous properties. Use only a grade 98 to 99 per cent pure. It may be obtained in either granulated or lump form, the former being the most convenient for use in fumigation.

Sulphuric acid should not come in contact with the hands or with the clothes, as it will severely burn the flesh and ruin the clothes. It should not be placed in metal receptacles, as it will soon eat them through.

Fumigate in the cooler parts of the day, and avoid, if possible, a temperature above 60° or 65° F., since at a higher temperature the plants are more liable to be injured.

The foliage of plants to be fumigated should be perfectly dry, otherwise it will absorb the gas and be burned.

The best shaped jar, when using two ounces of cyanide to a jar is one four or five inches in diameter and about nine inches high. If more cyanide is to be used in each receptacle larger jars must be used.

Always put the water into the jars first, adding the acid later. Never pour water into the undiluted acid.

After placing the sulphuric acid in the jars the bags of cyanide should be put in as soon as possible, for any delay will interfere with the proper reaction of the chemicals owing to the fact that the acid acts most powerfully when it first unites with the water. The manner of putting the bags into the acid is also important. They should not be held a foot or more above the jars and dropped in, as the bags may be thrown out by the reaction. Each bag must be carefully laid in the jar, but the fumigator must not lean over the jar as he does it, nor remain near it to watch the reaction. After a few fumigations the operator often becomes less attentive to the prescribed directions and precautions. This tendency should be promptly checked, the utmost care and caution being uniformly necessary.

#### CARBON BISULPHID.

Carbon bisulphid is used as a fumigant for aerial plant-lice, for root-lice and root-maggots, and for weevils in seeds. For methods to be followed in treating the first class mentioned, see page 226. For root-lice and root maggots, a small hole is made in the ground near the plant, and into it is poured a small tablespoonful of the liquid. The hole is then promptly closed and the maggots are killed by the fumes. The carbon bisulphid should not be poured on the plant above ground nor directly on the roots. For weevils, the seed should be placed in a tight box or bin, space being left at the top for a pan or other shallow dish for the carbon bisulphid. This should be used at the rate of one ounce to 60 cubic feet of box space, and the box should be kept closed for 24 hours. The vapor given off being heavier than air, descends, killing all insects present without injuring the seed.



As the fluid is inflammable, and its vapor, mixed with air, somewhat explosive, precaution should be taken never to permit a spark of fire to come in contact with it.

Carbon bisulphid may be obtained at drug stores for 20 to 35 cents a pound. A grade known as "Fuma Carbon Bisulphide," which is fully as effective for fumigation as the ordinary grade sold by druggists, is manufactured by E. R. Taylor, Penn Yan, New York, and furnished in 50 or 100-pound cans at 10 cents a pound.

#### SULPHUR.

Thorough cleaning of greenhouses for the eradication of insect pests should be practiced by the greenhouse gardener when the houses are empty, and fumigating with sulphur is one of the best and easiest means to this end. About one pound of sulphur should be burned to every 2,000 cubic feet of space, after which the house should be kept tightly closed for 24 hours, or longer if convenient. It is needless to say that at this strength all plants, as well as insects, will be killed.

For fumigating houses containing growing plants, evaporate a small quantity of sulphur in a suitable receptacle over a lamp or oil burner, taking care that it does not catch fire; or the steam pipes may be painted with a sulphur paste made by mixing sulphur and water. A paste is sometimes made in which the sulphur is mixed with oil instead of water. Sulphur is not only valuable as an insecticide, but useful in controlling mildew.

#### TOBACCO STEMS.

Though tobacco stems for fumigation purposes have been largely superseded by the recent introduction of various nicotine extracts, they are still used, and are recommended for killing plant-lice and thrips, especially when easily obtainable at a reasonable price.

Three piles of stems, of about half a bushel each, are used to every 100 linear feet of the house, the piles being dampened to prevent rapid burning. These are set on fire in the evening, when the building is left for the night. The house must be kept as tightly closed as possible until morning. Frequent fumigations—at least weekly—are necessary to obtain the best results.

#### NICOTINE PREPARATIONS.

Many nicotine preparations are now on the market under such trade names as "Nicoteen," "Nicoticide," "To-ba-ken," "Nico-Fume," etc. Most of them contain 25 to 45 per cent of nicotine, and are more effective, though more costly, than tobacco stems or tobacco dust. They may be used as fumigants in various ways. The commercially prepared fumigating papers are suspended in strips and lighted when ready to fumigate. Dry preparations are placed in shallow dishes and ignited. It is sometimes advisable to add a few drops of kerosene to facilitate their burning. The extracts are evaporated over a lamp, or, like the sulphur paste, are painted on the steam pipes. They evaporate or burn slowly, producing a powerful vapor. As a rule it is best to fumigate in the evening, keeping the houses closed over night. Most insect pests of the greenhouse may be controlled by thorough and oft-repeated fumigations with one of these extracts.



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# Illinois Farmers' Institute

CIRCULAR No. 5.



## Suggestions for Corn Contests.

(Approved and Adopted by the Illinois Corn Growers' Association, Jan. 25, 1912.)

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### TEN-EAR, THIRTY-EAR AND BUSHEL BASIS.

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**AGE CLASSES**—Boys, 14 to 16 inclusive. Young Men, 17 to 20 inclusive. Men, 21 and Above.

**VARIETY CLASSES**—1. All those varieties recognized as standard by the Illinois Corn Growers' Association. 2. General.

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1. Local corn shows and all entries and judging of exhibits must be done according to the rules and the score card of the Illinois Corn Growers' Association.

2. All corn shown must be grown by the exhibitor, and must be of the crop of the current season.

3. The territory covered by any special contest should be divided into sections; the larger the area from which the exhibits come, the larger the number of sections necessary.



4. If, for any reason, (i. e., immaturity) at the time of a contest it is impossible to remove the kernels to judge such points on the score card as kernel shape, kernel uniformity, or proportion of grain to ear, the marking on these points shall then be uniformly 80 per cent of the perfect score.

5. It is recommended that the prizes in any given show be widely distributed, a total of not less than five places when possible. A wide distribution of small prizes is preferable to a few large premiums.

6. Localities, towns, clubs, etc., wishing to conduct corn shows under the auspices of the Illinois Corn Growers' Association shall make application to the Secretary of the Association. (Leigh F. Maxcy, Curran, Illinois.)

The Secretary shall see that such a locality, town, or club, is supplied with suggestive rules, score cards, etc., and with such assistance as is desired.

The Executive Committee of the Corn Growers' Association and the standing committee on rules for contests shall assist the secretary whenever called upon.

### ACRE BASIS—BOYS CONTESTS.

1. Age limit, 15 to 20 years.

2. The acre used may be any shape most convenient to the grower. It must contain no more or no less than 160 square rods. It must have a border row of corn on each side and each end which shall be the same distance from the first corn row of the acre proper, as is the distance between the rows in the acre.

3. The name and type of seed corn used must be recorded.

4. The planning, and as nearly as possible, all the labor on the acre to be done by the contestant.

5. An account of the time required for each of the various operations should be kept; these include fertilizing, plowing, pulverizing, planting, cultivating, etc., as well as the manner of planting, hills, drills, listing, distance apart of hills, stalks per hill, etc.

6. If fertilizers are used, give kind, amount applied and cost.

7. Final measurement of the area and husking shall be done only under the supervision of the local committee of judges, one of whom shall be a representative of the Illinois Corn Growers' Association.

8. Samples of corn that are representative of the acre shall be taken by the local committee, and the per cent of dry matter determined according to the oil process.

9. The yield per acre shall be calculated to water free corn; this places all contestants on exactly the same basis, and gives every variety of corn used, an equal show.

10. The contest is to be judged by the following score card:

|                                                    |     |
|----------------------------------------------------|-----|
| Yield of water free corn .....                     | 80  |
| Completeness of report of work by contestant ..... | 20  |
| Total .....                                        | 100 |

Note 1. It is the sense of the committee that the above suggestions will lead to useful observation and information that may later be helpful to others and contribute to permanent advancement and welfare while a contest based wholly on yield of corn would fail largely in the object hoped for.

Note 2. Men's corn contests to be conducted under the same rules as above except that age limit is removed.

Note 3. As an assistance in keeping accurate records the secretary of the Illinois Corn Growers' Association will be prepared to furnish the following sheet to all contestants in yield per acre contests:



RECORD SHEETS.

Name ..... Age .....  
Address .....  
Where is the farm located? .....  
What is the character of the surface soil? .....  
Of the sub-soil? .....  
What crop was on the land last year? .....  
What did it yield per acre? .....  
Give crops and approximate yields from field for five years. ....  
What kind of plant food have you applied to this land in this time? .....  
What did they cost? .....  
What work was done before plowing? .....  
What tools were used? .....  
What time was required? .....  
When was the land plowed? .....  
What kind of a plow was used? .....  
What time was required for plowing? .....  
What work was done after plowing to prepare for planting? .....  
What tools were used? .....  
How much time required? .....  
When was the planting done? .....  
How much time required? .....  
What variety of corn was planted? .....  
What type of the variety? .....  
Was a germination test made of the corn? .....  
What was the percentage of germination? .....  
Was the corn drilled, checked or listed? .....  
What was the distance between rows? .....  
Distance between hills? .....  
How many hills per acre? .....  
How many stalks per acre? .....  
When did the first plants appear above ground? .....  
How many times was the corn cultivated? .....  
What implements were used? .....  
Approximate depth of cultivation? .....  
How much time required for each cultivation? .....  
When did the first tassels appear? .....  
The first silks? .....  
When was the corn husked? .....  
How many ears were produced on the acre? .....

It is suggested that contestants make as careful an estimate of the number of ears produced on the acre as possible, and compare this number with the number of stalks growing on the acre.

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THE SCORE CARD.

Entry No.....

| Corn score card to be used in corn judging contests. |                                           | Student's Score. |     | Instructor's Score. |     | Possible errors. | Student's errors. |
|------------------------------------------------------|-------------------------------------------|------------------|-----|---------------------|-----|------------------|-------------------|
|                                                      |                                           | No.              | No. | No.                 | No. |                  |                   |
| 1                                                    | Length of ear..... 10                     |                  |     |                     |     | 1                |                   |
| 2                                                    | Circumference of ear..... 5               |                  |     |                     |     | 1                |                   |
| 3                                                    | Color in grain and cob..... 10            |                  |     |                     |     | 1                |                   |
| 4                                                    | Shape of ear..... 10                      |                  |     |                     |     | 1                |                   |
| 5                                                    | Uniformity of exhibit..... 5              |                  |     |                     |     | 1                |                   |
| 6                                                    | Tips of ears..... 5                       |                  |     |                     |     | 1                |                   |
| 7                                                    | Butts of ears..... 5                      |                  |     |                     |     | 1                |                   |
| 8                                                    | Kernel uniformity..... 5                  |                  |     |                     |     | 1                |                   |
| 9                                                    | Kernel shape..... 5                       |                  |     |                     |     | 1                |                   |
| 10                                                   | Space between rows..... 5                 |                  |     |                     |     | 1                |                   |
| 11                                                   | Space between kernels at cob..... 5       |                  |     |                     |     | 1                |                   |
| 12                                                   | Vitality or seed condition..... 10        |                  |     |                     |     | 1                |                   |
| 13                                                   | Trueness to type..... 10                  |                  |     |                     |     | 1                |                   |
| 14                                                   | Proportion of shelled corn to ear..... 10 |                  |     |                     |     | 2                |                   |
| Total..... 100                                       |                                           |                  |     |                     |     | 2                |                   |
| Lack of legibility or promptness.....                |                                           |                  |     |                     |     | 3                |                   |
| Total errors.....                                    |                                           |                  |     |                     |     | 20               |                   |
| Student's rating.....                                |                                           |                  |     |                     |     |                  |                   |

.....Judge.

Name and address of exhibitor after exhibit has been judged:

.....

RULES FOR RECORDING ERRORS.

- (1) If on any one item the student places the samples in the same order as the instructor, no error shall be counted.
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- (3) If on any one item the student places samples in the opposite order from the instructor, one error shall be counted.
- (4) For each mistake in footing, one error shall be counted.
- (5) For illegibility or lack of promptness in doing the work the instructor may, at his discretion, count from one to three errors.
- (6) To find the student's rating, subtract his error from the possible errors (20) and find what per cent the difference is, of 20.
- (7) If there is a tie, or if several students have the same rating, the first place shall be given to the one whose footings are nearest to the footings of the instructor, and the second place to the one who stands second in this respect, etc.





# Illinois Farmers' Institute

CIRCULAR No. 5.



## Suggestions for Corn Contests.

(Approved and Adopted by the Illinois Corn Growers' Association, Jan. 25, 1912.)

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### TEN-EAR, THIRTY-EAR AND BUSHEL BASIS.

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**AGE CLASSES**—Boys, 14 to 16 inclusive. Young Men, 17 to 20 inclusive. Men, 21 and Above.

**VARIETY CLASSES**—1. All those varieties recognized as standard by the Illinois Corn Growers' Association. 2. General.

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1. Local corn shows and all entries and judging of exhibits must be done according to the rules and the score card of the Illinois Corn Growers' Association.

2. All corn shown must be grown by the exhibitor, and must be of the crop of the current season.

3. The territory covered by any special contest should be divided into sections; the larger the area from which the exhibits come, the larger the number of sections necessary.



4. If, for any reason, (i. e., immaturity) at the time of a contest it is impossible to remove the kernels to judge such points on the score card as kernel shape, kernel uniformity, or proportion of grain to ear, the marking on these points shall then be uniformly 80 per cent of the perfect score.

5. It is recommended that the prizes in any given show be widely distributed, a total of not less than five places when possible. A wide distribution of small prizes is preferable to a few large premiums.

6. Localities, towns, clubs, etc., wishing to conduct corn shows under the auspices of the Illinois Corn Growers' Association shall make application to the Secretary of the Association. (Leigh F. Maxcy, Curran, Illinois.)

The Secretary shall see that such a locality, town, or club, is supplied with suggestive rules, score cards, etc., and with such assistance as is desired.

The Executive Committee of the Corn Growers' Association and the standing committee on rules for contests shall assist the secretary whenever called upon.

#### ACRE BASIS—BOYS CONTESTS.

1. Age limit, 15 to 20 years.

2. The acre used may be any shape most convenient to the grower. It must contain no more or no less than 160 square rods. It must have a border row of corn on each side and each end which shall be the same distance from the first corn row of the acre proper, as is the distance between the rows in the acre.

3. The name and type of seed corn used must be recorded.

4. The planning, and as nearly as possible, all the labor on the acre to be done by the contestant.

5. An account of the time required for each of the various operations should be kept; these include fertilizing, plowing, pulverizing, planting, cultivating, etc., as well as the manner of planting, hills, drills, listing, distance apart of hills, stalks per hill, etc.

6. If fertilizers are used, give kind, amount applied and cost.

7. Final measurement of the area and husking shall be done only under the supervision of the local committee of judges, one of whom shall be a representative of the Illinois Corn Growers' Association.

8. Samples of corn that are representative of the acre shall be taken by the local committee, and the per cent of dry matter determined according to the oil process.

9. The yield per acre shall be calculated to water free corn; this places all contestants on exactly the same basis, and gives every variety of corn used, an equal show.

10. The contest is to be judged by the following score card:

|                                                    |     |
|----------------------------------------------------|-----|
| Yield of water free corn .....                     | 80  |
| Completeness of report of work by contestant ..... | 20  |
| Total .....                                        | 100 |

Note 1. It is the sense of the committee that the above suggestions will lead to useful observation and information that may later be helpful to others and contribute to permanent advancement and welfare while a contest based wholly on yield of corn would fail largely in the object hoped for.

Note 2. Men's corn contests to be conducted under the same rules as above except that age limit is removed.

Note 3. As an assistance in keeping accurate records the secretary of the Illinois Corn Growers' Association will be prepared to furnish the following sheet to all contestants in yield per acre contests:



RECORD SHEETS.

Name ..... Age .....  
Address .....  
Where is the farm located? .....  
What is the character of the surface soil? .....  
Of the sub-soil? .....  
What crop was on the land last year? .....  
What did it yield per acre? .....  
Give crops and approximate yields from field for five years. ....  
What kind of plant food have you applied to this land in this time? .....  
What did they cost? .....  
What work was done before plowing? .....  
What tools were used? .....  
What time was required? .....  
When was the land plowed? .....  
What kind of a plow was used? .....  
What time was required for plowing? .....  
What work was done after plowing to prepare for planting? .....  
What tools were used? .....  
How much time required? .....  
When was the planting done? .....  
How much time required? .....  
What variety of corn was planted? .....  
What type of the variety? .....  
Was a germination test made of the corn? .....  
What was the percentage of germination? .....  
Was the corn drilled, checked or listed? .....  
What was the distance between rows? .....  
Distance between hills? .....  
How many hills per acre? .....  
How many stalks per acre? .....  
When did the first plants appear above ground? .....  
How many times was the corn cultivated? .....  
What implements were used? .....  
Approximate depth of cultivation? .....  
How much time required for each cultivation? .....  
When did the first tassels appear? .....  
The first silks? .....  
When was the corn husked? .....  
How many ears were produced on the acre? .....

It is suggested that contestants make as careful an estimate of the number of ears produced on the acre as possible, and compare this number with the number of stalks growing on the acre.

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THE SCORE CARD.

Entry No.....

| Corn score card to be<br>used in corn judging contests. |                                        |     | Student's<br>Score. |     | Instructor's<br>Score. |     | Possible<br>errors. | Student's<br>errors. |
|---------------------------------------------------------|----------------------------------------|-----|---------------------|-----|------------------------|-----|---------------------|----------------------|
|                                                         |                                        |     | No.                 | No. | No.                    | No. |                     |                      |
| 1                                                       | Length of ear.....                     | 10  |                     |     |                        |     | 1                   |                      |
| 2                                                       | Circumference of ear.....              | 5   |                     |     |                        |     | 1                   |                      |
| 3                                                       | Color in grain and cob.....            | 10  |                     |     |                        |     | 1                   |                      |
| 4                                                       | Shape of ear.....                      | 10  |                     |     |                        |     | 1                   |                      |
| 5                                                       | Uniformity of exhibit.....             | 5   |                     |     |                        |     | 1                   |                      |
| 6                                                       | Tips of ears.....                      | 5   |                     |     |                        |     | 1                   |                      |
| 7                                                       | Butts of ears.....                     | 5   |                     |     |                        |     | 1                   |                      |
| 8                                                       | Kernel uniformity.....                 | 5   |                     |     |                        |     | 1                   |                      |
| 9                                                       | Kernel shape.....                      | 5   |                     |     |                        |     | 1                   |                      |
| 10                                                      | Space between rows.....                | 5   |                     |     |                        |     | 1                   |                      |
| 11                                                      | Space between kernels at cob.....      | 5   |                     |     |                        |     | 1                   |                      |
| 12                                                      | Vitality or seed condition.....        | 10  |                     |     |                        |     | 1                   |                      |
| 13                                                      | Trueness to type.....                  | 10  |                     |     |                        |     | 1                   |                      |
| 14                                                      | Proportion of shelled corn to ear..... | 10  |                     |     |                        |     | 2                   |                      |
| Total.....                                              |                                        | 100 |                     |     |                        |     | 2                   |                      |
| Lack of legibility or promptness.....                   |                                        |     |                     |     |                        |     | 3                   |                      |
| Total errors.....                                       |                                        |     |                     |     |                        |     | 20                  |                      |
| Student's rating.....                                   |                                        |     |                     |     |                        |     |                     |                      |

.....Judge.

Name and address of exhibitor after exhibit has been judged:

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